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# 1954 REVIEW of the PAINT INDUSTRY

Compiled and Edited by

SAM RUGGERI

IN COLLABORATION WITH THE EDITORIAL STAFF OF PAINT AND VARNISH PRODUCTION

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# PUBLISHER'S MESSAGE

IT is with great pride that we bring to YOU of the paint industry this 1954 Review.

As in previous compilations, every facet of the technical developments which have occurred in the coatings field during 1954 is covered in this Review. Thus, in whatever capacity of the paint field you may be engaged, this Review offers for your benefit the all-important "bird's eye" view of the industry from which you can properly evaluate new developments and trends for direct use in your daily work.

In the interest of improving the value of these compilations, we have expanded this year's Review to include two new and essential features.

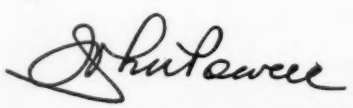
One is a compilation of Government Specifications and specification changes embracing some twenty-five military and federal agencies.

Another feature is the Suppliers' Trade Name Index, which is a compilation of the trade names of raw materials and equipment employed in paint manufacture. A brief description of the item is given together with the name of the supplier or manufacturer. Addresses of suppliers may be found in the Company Index.

We feel confident that the 1954 REVIEW OF THE PAINT INDUSTRY with its new features will, in a great measure, help to make your daily tasks easier by: (1) keeping you advised of new technical developments so that you may be able to give appropriate consideration to new ideas, materials, and techniques; and (2) broadening your background and outlook so that you may be capable of handling greater responsibilities.

We actively solicit your comments, advice, and criticisms so that we can improve subsequent issues of this Review in the years ahead.

By



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# HOW TO USE THIS REVIEW

THIS 1954 REVIEW of the PAINT INDUSTRY, the third in a series, is intended for selective reading and reference on the current developments in the paint industry. When used in conjunction with previous (and subsequent) reviews, the series forms a valuable index to the technical literature and source for information relating to the paint industry.

As illustrated in the Table of Contents, the material is presented in a related pattern. The format used provides 51 chapters; with these chapters being grouped together into 14 sections. The chapters are further sub-divided into various sub-headings, the number varying from one chapter to the next. In evolving this format an attempt was made to provide as many "niches" as necessary to cover the industry thoroughly while keeping the number to a minimum.

There are many ways to use this volume to good advantage. The Table of Contents provides an overall picture of the format as well as providing a reference to the general subjects. A more detailed subject reference is to be found in the Subject Index in the Appendix. An Authors' Index is provided in the Appendix to aid the reader who recalls his information by writer. Both of these indices refer to specific items rather than to the journal references.

Each item reference number is a three digit number such as 30.3.14. The first digit (30) refers to chapter thirty; the second digit (3) refers to sub-heading three; and the last digit (14) refers to the 14th item in this sub-heading.

The specific item refers the reader to the journal reference for further reading. Journal references have been centralized in one place and are found in the Appendix. This permits easier access to the reader, as well as permitting the reader to scan the list of articles for any one journal to select those articles of interest.

Many items come under the scope of more than one heading. Obviously, these items could not be included under all headings. Such articles have been catalogued in one "niche" and cross-referenced under the others. These cross-references, immediately following the last item under each sub-heading within a chapter, should be consulted along with the items for a complete picture of developments within the sub-heading.

Another new feature in this third review has been the inclusion of a list of suppliers at the end of each sub-heading within a chapter. Since this review is aimed at the paint manufacturing industry, this list has not been included in Chapters 38, 39, 40 which cover products of the paint industry. A complete tabulation of the manufacturers listed throughout the body of the volume has been included, together with addresses, in the Appendix.

Finally, a compilation of suppliers' trade names of interest to the paint industry has been included in the Appendix. It is hoped to make this compilation successively more complete with each review as new materials and equipment are introduced from time to time.


THE AUTHOR

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# HIGHLIGHTS

CHAPTER 1

# HIGHLIGHTS

## Introduction

**1.1.1.** The year, 1954, was considered a good year for the paint industry, although total sales did fall slightly short of the 1953 level, which was considered a record year for the industry.

Recent figures released by the Bureau of Census (Dept. of Commerce) show that total sales for 1954 amounted to 1,361,135,000. Comparing this total with 1953, which amounted to 1,402,733,000, we find that 1954 was some 3.0% less than 1953.

One of the most important factors contributing to this slight decrease in paint sales was the result of the "inventory recession" which dominated our national economy during the first half of 1954. This, naturally, caused a curtailment in the use of certain paint products, especially in the industrial field.

However, one of the most encouraging aspects affecting the paint industry is the booming "do-it-yourself" market. It has been estimated that do-it-yourselfers spent approximately $950,000,000 for paints and wallpaper during 1954 and that 70 percent of the interior painting in homes was done by one or more of the family members. Undoubtedly, the popularity of the "do-it-yourself" movement is due, in large measure, to the development of easy-to-apply products in many popular colors and with lack of odor.

A significant development of 1954 occurred in the technology of emulsion paints. In this field, considerable strides were made in the use of latices other than the styrene-butadiene types. The acceptance of polyvinyl acetate emulsion for formulating both interior and exterior finishes by the paint industry has resulted in the availability of this particular latex by many new suppliers. Properties claimed with polyvinyl acetate emulsion paints are quick dry, ease of washability, good adhesion to a variety of surfaces, excellent light stability, and weatherability. One of the reasons for the interest and acceptance of the PVA type of emulsion is the price advantage it has over other types of latices.

Acrylic emulsions also have made their mark in 1954. Paints based on this type of emulsion have been developed also for exterior use and preliminary tests have indicated good results. The main advantages of this type of emulsion are that it can be used on masonry or wood surfaces, and be completely odor free.

To capture their share of the consumer market, manufacturers of the odorless alkyd type paint have made improvements, especially in formulating techniques. Glycerol monoleate has been used with some degree of success in improving the compatibility of alkyds with odorless thinners.

Odorless vehicles based on epoxy resin for formulating flat wall finishes have recently been made available to the paint formulator.

Another interesting product designed for the "do-it-yourself" market was the introduction of thixotropic vehicles. An alkyd combined with small amounts of polyamide resins under certain cooking conditions produces a highly thixotropic body which can be formulated into gelled-type paint. The degree of thixotropy is so great that the introduction of the brush into the can causes the paint to flow, which can be brushed out smoothly without sagging.

Other important materials introduced to the paint industry during the past 12 months include: long oil alkyd for exterior house paints claimed to be non-blistering when properly pigmented; epoxy-alkyd combinations for floor finishes; styrenated-alkyds with fast drying properties; liquid based on butadiene for formulating paints with good resistance to scratching, harsh chemicals, corrosion, etc.; epoxidized oils; silicone vehicle which reduces efflorescence, spalling, cracking in exterior masonry finishes; terpene-based drying oil; line of pulp colors dispersed in water for latex paints (simply stir in latex base without grinding); aluminum paste containing inhibitor to prevent reaction with water; fine particle size silica extenders; and yellow nickel-titanium dioxide pigment; and leaded zinc oxide.

## General

**1.2.1.** Scofield reviewing the developments in the paint industry during 1953, states the outstanding development of the past two years in the field of coatings has been the wide acceptance of latex paints, particularly for interior use. Activity in fire-retardant paints has been high, and there continues to be great interest in the development of more satisfactory and generally applicable coatings for the prevention of corrosion of metals. (IEC-2)

**1.2.2.** Cook presents a resume of the 1953 Annual Review of the Paint Industry. This work is a one volume digest of the technical and commercial developments in all phases of the paint industry. The business and government pictures together with new develop-

ment in raw materials, production, formulation, testing, and surface preparation are discussed. (PVP-19)

**1.2.3** Burrell reviews the 1953 developments in protective coatings. Industry emphasis is on simple, versatile equipment for both the professional and do-it-yourself trade. Trade sales specialties boomed, with aerosol packaged paints leading in popularity and diversification. (CEN-6)

**1.2.4.** Armitage presents part two of a history of paints and varnishes in Great Britain. The author discusses the progress of painting in the medieval period—leading to the formation of the Paynter-Stayners' Guild. He outlines, also, the economic and working conditions of the industry, giving examples of typical costs and prices. (PM-4)

**1.2.5.** Arnold reviews paint technology and the law. While a legal training is not required of the paint technologist, difficulties can frequently be avoided by a broad knowledge of the principal impacts of the law. The technologist should not attempt to be his own lawyer, any more than he would expect to be his own dentist; but he should have some rudimentary knowledge of what may be called legal hygiene. (PM-18)

**1.2.6.** In this second part of the article on paint technology and the law, Arnold deals with flash-point regulations and luminous paint and considers the general effects of the Factories Act on paint technology. (PM-23)

**1.2.7.** Armitage presents part three of a history of paints and varnishes in Great Britain. The author describes the rapid increase in paint raw material imports following the colonization of overseas territories between 1500 and 1700, and discusses the influence of the Statute of Monopolies on the technology of the industry. A review of literature, including contributions to the Royal Society, is also given. (PM-33)

**1.2.8** Arnold concludes his series of articles on paint technology and the law. He discusses manufacturers liability under common law and considers contractual obligations and liability in tort-ie. liability for the harm caused to any user by carelessness in the preparation or packing of paint. He concludes with a summary of the information given in the three articles. (PM-35)

**1.2.9.** In the early days of the Royal Society of Arts there were no specialized scientific and technical institutions such as abound today. The Society, celebrating its bicentenary in 1954, thus had a broad interest in science and industry generally and the paint industry was one of many it helped by initiating discussion of new precesses and techniques. To some extent the R.S.A. can be considered a forerunner of modern technical institutions. (PM-40)

**1.2.10.** Kienle, in his Keynote address at the 1953 Annual Meeting of the Federation of Paint and Varnish Production Clubs discussed the Protective Coatings Industry as a practical science. Included were mention of the transition from the trial and error stage to the present scientific industry, influence of demands of the customers and scientific milestones. (OD-16)

**1.2.11.** Armitage describes the development of the paint industry in Great Britain in the 18th Cnetury. That it saw the laying of the foundation of the industry as it is now known is shown by such discoveries as Prussian Blue and the comparatively large number of patents taken out for oils, varnishes and colors. These developments, coupled with increased mechanization, paved the way for the establishment of the modern industry. (PM-45)

**1.2.12.** Sayles discusses organizing for surface coatings research. The goal of every successful research organization should be a well-informed supervisor working with a satisfactory and happy group of research workers. Emphasis should be placed on the following factors to accomplish this:

1. Careful selection of research personnel
2. Pleasant environmental surroundings
3. Fairness in administration
4. Clear-cut delegation of authority
5. Reduction of personnel turnover through incentives
6. Discreet regulation of research personnel
7. Exact definition of research objectives and program
8. Maintenance of high employee morale.

(OD-22)

**1.2.13.** Heiberger discusses the role of petrochemicals in paint. All petrochemicals are the consequence of unique chemical transformations which give rise to intermediates not normally present in crude petroleum. They are produced by:

1. thermal and catalytic cracking
2. dehydrogenation
3. alkylation
4. isomerization
5. polymerization
6. cyclization and aromatization.

Groups covered include products from:

1. paraffin
2. olefins
3. diolefins
4. naphthenic chemicals
5. acetylene
6. aromatics from petroleum
7. miscellaneous intermediates.

(PVP-44)

**1.2.14.** To provide adequate facilities for its expanding program of basic research in the field of surface technology, the Research Division of New York University's College of Engineering has recently established a new Surface Technology Laboratory. Dr. Max Kronstein directs the surface technology program. (PVP-47)

**1.2.15.** Sayles presents the following outline for handling coating complaints:

1. Acknowledge promptly
2. Handle complaints diplomatically
3. Investigate the cause of the complaint
4. Attempt to correct the complaint and satisfy the customer
5. Replace defective merchandise
6. Adopt results from the complaint

(OD-40)

**1.2.16.** Flexible ceramic coatings that can be applied to a wide variety of materials have been developed by Armour Research Foundation. They are not brittle and can be applied to almost any clean solid at a few hundred degrees Fahrenheit. (CEN-23)

**1.2.17.** In the nineteenth century the paint industry began to apply the fundamental advances in chemistry made in the previous

century. Armitage points out the use of formulae based on Dalton's atomic theory and the application of Davey's electrochemical work. These advances, coupled with the publication of more information on the industry, foreshadowed the technical age to come. (PM-62)

**1.2.18.** Renson describes how market research helps industry to evaluate potential markets and thus expand sales profits. Included is the preparation and handling of a survey questionnaire, and the use of the field data. (IR-5)

**1.2.20.** Gardner discusses the "Big Deal" of industrial paint samples. Over 80,000 gallons of paint are shipped annually as paint samples. Here are some questions to consider before sending a sample of paint or finishing material:

1. Are you sure you are contacting the right man?
2. Does he want your sample?
3. Will he give it a fair test soon?
4. Do you know his shop conditions and facilities?
5. And his paint or finish requirements or specifications?
6. Do you feel reasonably sure that the sample of material you are sending will do the job effectively, on the basis of its performance and cost? (IF-44)

**1.2.21.** Fair discusses the requirements for a new paint salesman and for rating his effectiveness. The sole criterium is not "is he selling?" but other aspects such as does he fit into the organization and is he an asset to the organization and these must be considered. (APJ-17)

**1.2.22.** Smith, in Lecture XIX in the Third Ten-Year Practical Paint Course, sponsored by the New England Production Club, discusses the merchandising of paint.

In the selling of any product, four factors contribute to the total sales success. They are, the product itself, its distribution, its merchandising, and its advertising. For total sales effectiveness, each one of these factors must be geared to its maximum efficiency. (APJ-28)

**1.2.23.** Connolly discusses the many aspects of selling in the paint industry. Included are the "Seven Sign Posts of Selling":

1. Always have something new to show
2. Time your calls
3. The presentation is everything
4. Demonstrate
5. Learn to say the right thing
6. Keep a written record of your work—of your calls.
7. Be a nice guy. (APJ-32)

**1.2.24.** Fair discusses how job enthusiasm means more work from employees. As employers must cut corners, shave expenses and get more for the bulk expenditures of his dollars, the question of what he can do to get more work from his present staff is of importance. The creation of greater job enthusiasm is the answer to this problem of getting more work from the employee. (APJ-67)

**1.2.25.** Stevens discusses the "guaranteed annual wage" and how it will affect the paint industry. Three plans are presented and discussed. The guaranteed annual wage seems to be simply an extension of the unemployment insurance program. The whole program should be thoroughly understood before entering into any possible negotiation. (APJ-73)

**1.2.26.** Gray discusses the legality of restrictions against competition. A number of cases are cited involving contracts placing limitations against unfair competition by employees leaving and joining competing organizations.

"Whatever restraint is larger than necessary for the protection of the party, can be of no benefit to either; it can only be oppressive and if oppressive it is in the eye of the law unreasonable. Whatever is injurious to the interests of the public is void on the ground of public policy." (APJ-75)

**1.2.27.** What do you do when you are stuck for an idea? Fair presents a few ideas which should help when working on a problem and looking for an idea to get started. When stuck for an idea, staring out of a window seldom develops anything more than a sizeable headache. How much more valuable is it thumbing through old trade journals, file card indexes or a "tickler file" of ideas. (APJ-77)

**1.2.28.** Whittaker reports paint sales set record in 1953. Topics reviewed are general improvement, new emulsion type sealer, home owner interest, and new plants. (CPVM-20)

**1.2.29.** Zucker discusses patents, copyrights and trade marks. Differences as to acquisition, need for application to government, need for marking, term of monopoly, and scope of monopoly are discussed. Their value to the typical paint company is described. (PIM-15)

**1.2.30.** Singer presents Chapter IX Formation (Part II) of his Fundamentals of Paint, Varnish, and Lacquer Technology. Included are—composition of pigments and vehicles, fineness of pigment, application properties, degree of grind, film properties, cost requirements of specific finishes, manufacturing considerations in formulation, mixing, grinding, cooking oils and varnishes vs buying prepared vehicles and typical method of figuring a formulation. (APJ-27)

# RESINS AND OTHER FILM FORMERS

## CHAPTER 2

# GENERAL RESINS

### General

**2.1.1** Morgan describes the moisture permeability of a wide variety of polymeric film-forming materials, determined at 39.5°C. and a vapor pressure difference across the film equivalent to 53 mm of mercury. The data indicate that most polymers possessing low moisture permeability have:

(1) A saturated or nearly saturated carbon chain

(2) A minimum of chain branching

(3) A high degree of lateral symmetry

(4) A fair degree of longitudinal symmetry

(5) A very high proportion of relatively small, nonhydrophilic substituents. Physical factors, such as orientation and crystallinity, may also contribute to reducing permeability.

Over 100 polymers were examined; of these only 20 had permeabilities below 20 grams of water vapor per 100 m.² per hour at a thickness of 0.002 inch. These included polyethylene, rubber hydrochloride, vinylidene chloride copolymers, polytetrafluoroethylene, polychlorotrifluoroethylene, and isobutylene-isoprene copolymers. (IEC-5)

**2.1.2** Bernhardt studied the effects of ultrasound on pure melts of high polymers. In the ranges of temperatures and frequencies investigated, ultrasonic energy had no depolymerizing effect upon thermoplastic melts. Ultrasound could cause molecular orientation in molten polymer without physical deformation of the polymer. (IEC-51)

**2.1.3.** Hanau reviews the compatibility of polymeric materials. Various phases of the problem of blending several polymeric materials are discussed. The formulator of surface coatings must do a great deal of blending and modifying the various resins and modifiers. Due to the endless possibilities of combinations to be tested, a simplification of the rules governing mutual compatibility is highly desirable. (PVP-29)

**2.1.4.** Synthetic noncyclic all-cis diene polymer closest approach yet to natural rubber molecule. The first such polymer has been prepared at University of Maryland, and the method used in its preparation will permit synthesis of other all-cis diene polymers. (CEN-10)

**2.1.5.** Polyaminotriazoles, condensation polymers developed in the Laboratories of British Celanese show promising possibilities; commercial feasibility is keyed to low-cost hydrazine and sebacic acid. (CEN-11)

**2.1.7.** Thirty or more years ago, the manufacture of paint and varnish was art, pure and simple, and it was performed mostly by practical men ungraced by university degrees. Gradually, this situation changed as paint, oil, and resin chemists began asking fundamental questions about the factors that affect protective coatings. Among the most significant developments has been the creation of an ever-widening range of improved synthetic resins (chronological table included in article). Today, chemists have sufficient knowledge of paint fundamentals so that resin molecules can be tailor-made to meet exacting performance requirements. (CEN-15)

**2.1.8.** Chang & Kummerow found that the autoxidation of ethyl linoleate at 30° C. for 350 hours could be separated into fractions of increasing polarity and molecular weight by extraction with solvent pairs of Skellysolve F and diethyl ether. The analytical results obtained on characterization of the more polar polymer fractions indicated that the oxidative polymers of ethyl linoleate were linked through carbon to oxygen bonds rather than carbon to carbon bonds. This postulation was substantiated by a successful depolymerization of the polymers and the catalytically hydrogenated polymers with HCl, HBr, or HI in aqueous ethyl alcohol. Characterization of the depolymerized product also indicated that the oxidative polymers were joined through carbon to oxygen bonds. (JAOCS-2)

**2.1.9.** Kitchener discusses the progress in colloid chemistry. Colloid chemistry has lost its former aura of mystery, and is rapidly passing from a descriptive into a quantitative science. This change has been made possible partly by the introduction of modern experimental techniques and partly by progress in the fundamental sciences of surfaces and macro-molecules.

The origins of the peculiarly "colloidal" phenomena such as light-scattering, abnormal viscosity, stabilization, coagulation, etc., are well established and can be readily understood in terms of a rational scheme of classification of colloids. Current interest attaches to theoretical attempts to represent these phenomena by quantitative theories, and already encouraging success has been achieved.

The state of progress on some of the principal advancing fronts of colloid science is briefly indicated, in non-mathematical terms. (JOCCA-35)

**2.1.10.** Stone & Burg report on arsine borines and arsinoborine polymers. The methylarsines form borine complexes which are more easily dissociated than the corresponding phosphine borines, but show a similar increase of stability, and difficulty of losing hydrogen, with methylation. The protolytic reactions occur far more readily than those of the phosphine borines, with formation of fairly similar polymers, such as those of the $(CH_3)_2AsBH_2$ unit. (JACS-26)

**2.1.11.** Seymour presents basic criteria for evaluating some plastic materials of construction. Fundamental information about plastic materials as to their generic characteristics is followed by a discussion of the atomic construction of the principle classes of plastic materials. Differences in the chemical resistance of polar and non polar materials are explained. Thirty of the principal plastic materials are considered with respect to their composition, resistance to corrosives, techniques for use, and some of the principal uses of each as structural materials. (C-3)

**2.1.12.** Shepard gives a number of case histories in which experimental or emergency use of plastics as materials of construction has subsequently led to their formal adoption. Principle materials referred to are the various polyester laminates, polyvinylidene chloride and fluorocarbons. The author cites the need for a reliable mondestructive test for the physical properties of reinforced plastics. Accounts are given of successful use of plastics in gas and liquid phase operations involving various corrosives. (C-11)

**2.1.13.** Alexander studied the polymerization of monosilicic acid in 0.1 molar solution at 1.90° over the pH range of about 1 to 6. Below pH 3.2, the degree of polymerization increases linearly with the square root of time. The slope of the polymerization changes above pH 3.2. Also, below pH 3.2 the polymer appears to be relatively homogeneous with regard to molecular weight distribution; above pH 3.2 a hetergeneous distribution is found. At pH 6, monosilicic acid polymerizes almost instantly. The freezing point method was used to determine the number average molecular weight of the polysilicic acid. (JACS-47)

**2.1.14.** Butler & Goette have prepared and characterized eight unsaturated quaternary ammonium bromides and one unsaturated tertiary amine. The quaternary ammonium bromides were polymerized by use of peroxide catalysts, and some of the properties of the polymers determined. It was shown that the double bond of the butene-2 structure did not enter into the polymerization, and that this residual double bond caused a decrease in the basic properties of the resulting polymer. (JACS-50)

**2.1.15.** Patrick & Burton report on polymer production in radiolysis of benzene. Irradiation of liquid benzene with 1.5 Mv. electrons gives polymer as a nonvolatile product with a 100 e.v. yield G ($C_6H_6$—polymer) = 0.75 independent of intensity and total energy input. Average molecular weight increases non-linearly with energy input (max. ca 530). G (double bond formation) decreases linearly with input independent of intensity. (JACS-51)

**2.1.16.** Cairns, et al, report on olefin-carbon monoxide-alcohol copolymers. The radical-initiated copolymerization of ethylene and carbon monoxide in methanol at high pressures gives copolymers containing chemically-bound methanol. The replacement of ethylene by other olefins or of methanol by other alcohols gives analogous copolymers. (JACS-55)

**2.1.17.** Burg & Wagner studied polymeric thioborines, methanethiodiborane and related substances. Present results are consistent with the assumption that methylated sulfur has more electron-donor bonding power than oxygen in similar complexes or polymers, but far less than methylated phosphorus or arsenic. (JACS-57)

**2.1.18.** Tobolsky & Catsiff propose a law of corresponding states for the viscoelastic properties of amorphous polymers in the transition region. Tables are presented from which the modulus-temperature curve (modulus measured after any fixed time $t_1$) can be constructed for many polymers. (JACS-70)

**2.1.19.** Schuur attempts to draw a clearer picture of the mechanism of crystallation. In this article a conception of the mechanism of crystallation is given, on the basis of which, it is suggested the origin of spherulites might be explained. A tentative explanation of several related phenomena is based on the new concept. (JPS-7)

**2.1.20.** Katchalsky and Lifson calculated the electrostatic free energy of randomly kinked, ionized, macromolecules for polyelectrolyte solutions of finite strength. A detailed analysis of the charging process and the reference state of the free energy is given. The mutual electrostatic repulsion of the fixed charges on the macromolecule is the main part of the electrostatic free energy. (JPS-9)

**2.1.21.** Keller proposes a new approach to orientation processes in terms of the morphology of crystalline polymers. The various stages of this process are discussed. Several anomalous and hitherto unexplained orientation effects frequently described in the literature can be accounted for. Preferential tilt of the chains with respect to the fiber axis can now be explained. (JPS-20)

**2.1.22.** Slone & Reinhart measured the properties of 168 samples of commercially available plastics films from 27 manufacturers. The results of tests to determine tensile tear, folding endurance, water absorption, water vapor permeability, low temperature impact, change in linear dimensions on heating, specific gravity and flammability properties are summarized. Materials included

Cellophane
Cellulose Acetate
Cellulose Acetate Butyrate
Cellulose Triacetate
Ethyl Cellulose
Polyethylene
Polystyrene
Polyester
Saran
Polyvinyl Alcohol
" Chloride & Copolymers
Polyvinyl Chloride—Saran laminate
Polymethyl Methacrylate

(MP-27)

**2.1.23.** Sun discusses the effects of atomic radiation on high polymers. Since high polymers are covalent substances, the effect of radiation is largely caused by

ionization and electronic excitation. These processes cause instantaneous flow of electric current and the breakage and rearrangement of chemical bonds, and the formation of free radicals. Consequently, chemical reactions are initiated. The phenomenological results include gas liberation, double-bond formation and elimination, degradation, polymerization, cross linking and vulcanization, vitrification, hydrogenation, and others. As a consequence, many important physical properties are changed.

The implications of atomic radiation are far reaching in their practical respect. Understanding of the deleterious effects has already resulted in development of high polymers that will withstand intense radiation. Studies of beneficial effects indicate that atomic radiation provides to the scientific and technical world a new experimental variable or tool unique in itself. Already, high polymers of better physical or chemical properties are produced that cannot be achieved otherwise. (MP-33)

**2.1.24.** Kirkwood reviews the general theory of irreversible processes in solutions of macromolecules, previously formulated by the author. Applications of the theory to viscoelastic behavior, flow birefringence, and the Kerr effect, and to dielectric dispersion are presented in outline. (JPS-22)

**2.1.25.** Kreussling & Ullman have developed a theory of the excluded volume of branched molecules. The model of the branched molecule is a main or backbone string of beads from which side branches, which are themselves unbranched, originate. Each of these beads has the property of the Kuhn statistical chain element. The calculation is based on the Fokker-Planck equation as used by Hermans and collaborators. The differential equation therefrom is not solved, but the average squared distance between two segments of the main chain is obtained. (JPS-26)

**2.1.26.** Farthing & Reynolds describe the synthesis and properties of a new polyether. 3,3-bis (chloromethyl)—1-oxabutene may be polymerized in the presence of powerful electrophilic catalysts such as boron trifluoride; minute traces of water are also necessary for polymerization to proceed. The resulting-polyether, poly 3,3-bis (chloromethyl)-1-oxabutene, is an inert, highly crystalline and insoluble polymer, m.p. 180°, capable of forming oriented films and fibers. (JPS-41)

**2.1.27.** Biletch indicates how the physical characteristics of polymers depend on their chemical structure. Steric interaction and polarity are the two principal factors to be considered in tailor-making a linear macromolecule. Present-day theory enables us to predict the physical properties of linear polymers in a semi-quantitative manner. These same general principles apply to the thermoset, cured or cross-linked polymers although only qualitative correlations are possible. Studies of the mechanism of gelation, gel structure and properties will lead to a more accurate analysis and better understanding of cross-linked resins. (IR-7)

**2.1.28.** A process for the production of a fluorescent resinous material which comprises reacting an aryl-substituted alkyl halide with an alkenyl ether of a polyhydroxy organic compound in the presence of an aqueous alkaline medium at condensation reaction conditions. (USP-39)

**2.1.29.** A process for producing a synthetic resin which comprises reacting a carbonyl compound selected from the group consisting of aldehydes and ketones with the condensation product of from about 5 to about 25 mols of a phenol having at least two nuclear hydrogen atoms, from about 25 to about 45 mols of an aromatic hydrocarbon having at least two nuclear hydrogen atoms and an alkyl group of not more than two carbon atoms, and from about 50 to about 75 mols of a conjugated aliphatic diene hydrocarbon. (USP-45)

**2.1.30.** Water-soluble resinous condensation products of at least one aldehyde of the formula RCHO, wherein R is selected from the group consisting of hydrogen and saturated and unsaturated aliphatic hydrocarbon groups containing from one to three carbon atoms and at least one ketone of the formula R'R"CO, wherein each of the substituents R' and R" is an alkyl group wherein R' plus R" is not more than four carbon atoms, containing at least one sulphonic acid group. (USP-110)

**2.1.31.** A resinous linear polymeric amidophosphonate comprising the recurring structural unit

wherein R represents a member selected from the group consisting of an alkyl group containing from 1 to 4 carbon atoms, a phenyl group and a cyclohexyl group and $R_1$ represents an aromatic group selected from the group consisting of a phenylene group, a diphenylene group and a diphenylene sulfone group. (USP-143)

**2.1.32.** The method of preparing new monomeric, thermosetting products which comprises heating and agitating, in an inert atmosphere and in the presence of a volatile organic liquid which distills over in form of an azeotropic mixture with water, an $\alpha,\beta$-unsaturated dicarboxylic acid with about the stoichiometric amount of the cyclic adduct of a conjugated diene and a $\beta,\gamma$-unsaturated alcohol, separating the constituents of the distillate from each other, returning the volatile organic liquid to the reaction mixture, and finally removing the agent and any unreacted material. (USP-147)

**2.1.33** The process for producting a resinous reaction product which comprises reacting under aqueous conditions, acetone and formaldehyde with the mole ratio of acetone to formaldehyde being 1 mole of acetone to about 3 to about 5 moles of formaldehyde, said reactants having a strongly alkaline reagent added thereto, said reaction after initiation upon the application of external heat proceeding exothermically due to the addition of a sufficient quantity of said agent thereto, said exothermic reaction reaching temperatures in the range of 160-210° F., the total amount of said agent employed being approximately the alkaline equivalent of sodium hydroxide measuring 1 to 3% of the combined weights of said acetone and formaldehyde when

the mole ratio of acetone to formaldehyde is 1 to 3, 1.5 to 4% of the combined weights of acetone and formaldehyde when the mole ratio of acetone to formaldehyde is 1 to 4, and 2 to 6% of the combined weights of acetone and formaldehyde when the mole ratio of acetone to formaldehyde is 1 to 5, the resinous reaction product produced thereby being thermosetting, measuring by weight at least 75% of the combined weights of acetone and formaldehyde and being soluble in twice its volume of water. (USP-148)

**2.1.34.** The General Electric Company has issued 12-page brochure "GE Serving The Paint Industry", describing various General Electric types of resins for the paint industry.

**2.1.35.** Howard & Sons (Canada) Ltd. has issued 10-page bulletin TS-25 describing properties and uses of Resin MS-2; an alicyclic ketone resin obtained by the condensation of cyclic ketones.

**2.1.36.** Researchers of Imperial Chemical Industries, Ltd. have prepared a polyether by the polymerization of 3,3-bis (chloromethyl) oxacyclobutane.

cf: 39.1.12
50.9.1

**Alkyl Titanates**

**2.2.1** Winter has prepared polymeric butyl esters of titanium by partial hydrolysis of the monomer using various amounts of water dissolved in butanol. The direct preparation of polymeric butyl titanate from titanium tetrachloride, butyl alcohol and water on a pilot plant scale is described. Yields of 80 per cent were obtained.

Hydrolysis is quantitative on addition of up to about 1.5 mol-equivalents of water. On further additions only a portion of the water added enters the reaction. A portion is adsorbed and some remains in the solvent.

Molecular weights of some of the polymers were determined and ranged from 620 to 1400. (JOCCA-13)

**2.2.2** The rates of hydrolysis of monomeric n-butyl, sec-butyl, tert-butyl, n-hexyl, n-octyl, "Alphanol" and "Nonanol" titanium esters as well as those of a number of polymeric n-butyl esters have been determined. Ultimate analyses of some of the hydrolysis products have been made. It is concluded that concurrently with the hydrolysis that takes place on exposure to atmospheric moisture, water is adsorbed by the hydrolytic products. Polymeric butyl titanates prepared by partial hydrolysis employing 1.0-1.5 mols of water have the best film forming properties.

Attempts have been made to explain the variation in the suitability of different pigments by differences in adsorptive activity. Considerable differences in hardness and adhesion have been found in butyl titanate films pigmented with samples of alumina known to differ in adsorptive activity. (JOCCA-14)

**2.2.3.** Method for preparation of alkyl titanates which comprises admixing titanium tetrachloride, an alcohol selected from the group consisting of primary and secondary monohydric non-substituted aliphatic alcohols having at least two carbon atoms, and liquefied ammonia in a closed system said ammonia being present in amount at least equal to that required to react with the chloride ions released from the tetrachloride plus that required to dissolve the ammonium chloride formed by the reaction, and separating the liquid alkyl titanate layer from the liquid ammonia-ammonium chloride layer, the entire process being carried out in the anhydrous state. (USP-43)

cf: 39.7.1
39.7.2

CHAPTER 3

# ACRYLIC RESINS

### General

**3.1.1.** Spilner gives details on embedding in acrylics. Complete details on the process, from preparation of materials to be embedded to machining the finished casting are given. (MP-7)

**3.1.2.** Feuer and Lynch have prepared unsaturated N-methylolamides, a new class of compounds. The synthesis of N-methylolmethacrylamide, N- methylolacrylamide and N,N′-bis-(methylol)-fumaramide as well as some of their derivatives are reported. Upon heating, N-methylolmethacrylamide and N-methylacrylamide have been converted to infusible polymers which are insoluble in common organic solvents. (JACS-4)

**3.1.3.** Grinsfelder, et al, discuss new acrylic resins for coatings. As a group acrylic resins offer:

1. Water white color and transparency
2. Resistance to discoloration at high temperatures
3. Resistance to water, alcohol, alkali and acid
4. Resistance to mineral oil, vegetable oil and grease
5. Good electrical properties
6. Relatively high resistance to burning
7. Low pigment reactivity
8. Resistance to chemical fumes
9. Good film flexibility and film life (no extractible, migratory, or volatile plasticizer in the film). (OD-37)

**3.1.4.** Electrolytic conductance and transference measurements have been made (Wall & Doremus) on solutions of polyacrylic acid partially neutralized with sodium hydroxide. The fraction of sodium ions bound to polymer ions, the polymer ion mobility, and the polyion transference number all decrease with increase in polymer concentration. The bound sodium fraction remains substantially independent of temperature from 0 to 42°. Substituting potassium for sodium does not alter the bound carbon fraction and polyion mobility. (JACS-39)

**3.1.5.** Ehrlick & Doty prepared and characterized copolymers of methacrylic acid and 2-dimethylaminoethyl methacrylate ranging in composition from 23-57 mole per cent methacrylic acid. It has been found that ionization of the monomers exerts a marked influence on the propagation reactions in methanol, invalidating the application of the two-component copolymerization equation. (JACS-67)

**3.1.6.** Leonard, et al, prepared liquid polymers of ethyl, n-butyl, and 2-ethylhexyl acrylates using an ionic initiating system. Liquid polyethyl acrylate was tested as a plasticizer in a stabilized and unstabilized polyvinyl chloride plastisol composition. In unstabilized composition, fused samples were comparable in color to a DOP plasticized sample. In stabilized composition, a film was obtained showing higher tensile strength yet equivalent ultimate elongation as compared to a DOP plasticized sample. (JPS-17)

**3.1.7.** Morawetz and Gobran studied the osmotic pressure of solutions of mixed acidic and basic polymers. Methyl methacrylate was copolymerized with small amounts of methacrylic acid or dimethylaminoethyl methacrylate. A thermodynanic analysis of the data showed that under certain conditions the activity of one or the other polymer component decreases with increasing concentration of the mixture. (JPS-27)

cf: 2.1.1
16.1.18
18.1.2
18.1.14
34.1.2
36.9.3
49.1.7

Manufacturers:
American Cyanamid Company
E. I. duPont de Nemours & Co., Inc.
Rohm & Haas Company

### Methyl Methacrylate

**3.2.1.** Melville & Watson discuss the polymerization of methyl methacrylate by its polymer. Addition of its polymer causes methyl methacrylate to polymerize. The extent of polymerization is linear with time to at least 5% conversion at 60-90°C. The rate of polymerization is proportional to the first power of the concentration of added polymer and independent of its molecular weight. The molecular weight of the polymer formed increases with increase in reaction temperature. No polymerization caused by polymer occurred with the other polymer/monomer systems tested. The rate and nature of the initiating reaction are discussed. (JPS-2)

cf: 2.1.22
3.1.1
16.1.17
18.1.2
18.1.11
18.1.14
20.2.1
44.2.8
44.2.10

Manufacturers:
E. I. duPont de Nemours & Co., Inc.
Rohm and Haas Company

## CHAPTER 4

# ALKYDS

### General

**4.1.1.** Fitzgerald discusses the deterioration of alkyd resin films by light below 3000°A. The purpose of the investigation discussed was to determine the rate, the geometrical location or site of attack, its approximate relationship to wave length, and its dependence upon oxygen concentration. (IEC-19)

**4.1.2.** This concluding part of the article on the work of the Resins Service Department laboratories of the Dyestuffs Division, I. C. I., on the effect of variations in type and properties of alkyd resin finishes concludes the discussion of gas checking and wrinkling problems and summarizes the results of the work.

One of their conclusions is that cobalt alone gives fairly satisfactory results in some alkyd resin finishes, but when blooming is encountered and the cobalt proportion must be reduced, a lead-cobalt-calcium mixture is the most satisfactory drier mixture yet devised. In particular, good results are obtained with mixtures of 10 parts of lead with 1 part of cobalt and between 5 and 10 parts of calcium. (PM-20)

**4.1.3.** The cohesive mechanical properties of certain alkyd resin pigmented and unpigmented films have been investigated by Snoddon and Carrick. The methods used involved stress-strain and stress relaxation tests on films removed from their substrata. The tests were conducted at constant temperature and humidity.

The paints were prepared in laboratory pebble mills and applied on tin-coated steel panels using a doctor blade technique. After baking, the films were stripped by amalgamating the tin coating.

The mechanical properties of paint films are discussed, and classical theories of viscoelastic behavior are applied to the stress relaxation of the unpigmented material, with good agreement between theory and observed results being obtained using the generalized Maxwell model.

A theory for the increase in stiffness due to the addition of inelastic dispersed spheres to a viscoelastic matrix is applied to the pigmented alkyd film with poor results. The factors causing these deviations are:

1) For any given type of pigment the dispersion of the pigment particles is less than that required by the theory This tends to cause an increase in modulus, or stiffness, over that theoretically predicted. Dispersion also varies with pigment particle size.
2) The pigment-vehicle bond very likely is localized at various areas of the pigment-vehicle interface, as opposed to the assumption that the bond is not localized. This also tends to cause an increase in the modulus over that theoretically indicated.
3) Drier adsorption occurs which lowers the degree of polymerization of the pigmented film compared to that containing no pigment. This tends to lower the modulus below that predicted by the theory. Drier adsorption, being a surface phenomenon, varies with pigment particle size.

For any given type of pigment, the variations in breaking strain are accounted for by these three factors. The cohesive mechanical properties of films containing the different types of pigments differ markedly, due to different pigment surface properties.

The theories of viscoelastic media may be used to study the cohesive mechanical behavior of protective coating films with satisfactory results. (OD-32)

**4.1.4.** Hempel discusses the formulation of short oil alkyd resins with 2.4 mols of glycerine to 3 mols of phthalic anhydride, or 20% excess glycerine over theoretical. Viscosity control was obtained with ethylene glycol, Benthal and larger quantities of excess glycerine. A relationship between the various amounts of these materials to process short oil alkyds to low acid values is presented. Film evaluation of these resins suggests the use of Benthal as the best viscosity control agent. (OD-44)

**4.1.5.** Chipault & McMeans present results of studies on oxidized films of trilinolein and trilinolenin. Previous work has been reported. This present study employed much larger film areas. The films were collected at two levels of oxidation, and after the peroxides has been determined the remainder of the films was reduced and saponified. The hydroxyl, alpha glycollic, and carbonyl content, and the unsaturation of the free acids were then measured. In addition, the neutralization equivalent, molecular weight, and ultraviolet and infrared spectral characteristics of the acids were determined. (OD-48)

**4.1.6.** Rheineck & Brice studied the pinitol & quebrachitol esters of linseed fatty acids. Pinitol &

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quebrachitol esterify with linseed fatty acids at a rate somewhat slower than glycerol and faster than inositol. Esterification rates, physical, chemical and film properties of the esters of these two cyclitols appear to be identical. The viscosities of the cyclitol esters are in all cases greater than those of pentaerythritol esters at some degree of polymerization. The cyclitol esters have drying times similar to those of the corresponding monopentaerythritol esters and a little slower than those of the dipentaerythritol ester. Film toughness is similar to that of tripentaerythritol esters. Heat bodying of the cyclitol esters reduces their drying speed. (JAOCS-29)

**4.1.7.** Swann & Esposito discuss the analysis of alkyd resins modified with vinyl chloride-acetate copolymer. A method is presented whereby the vinyl is precipitated and the alkyd can then be analyzed. (AC-14)

**4.1.8.** Bragdon discusses glycerine alkyds tailored to need: how the formulator, knowing what he wants the resin to do, can go about making his selection on a sound, practical basis. Included are alkyd resin ingredients, properties imparted by each ingredient, and the selection of the best alkyd for a particular requirement. (APJ-34)

**4.1.9.** Bragdon presents part II of his paper describing glycerine alkyds tailored to need. His discussion includes alkyd processing methods, how solvent cook shortens time, styrenated alkyds, oil length and resin manufacture versus purchase! (APJ-63)

**4.1.10.** An alkyd resin comprising the reaction product of a polybasic carboxylic acid, a polyhydric alcohol, and the copolymerization product of rosin with a monomer of the class consisting of styrene and methyl methacrylate in the presence of a peroxide catalyst and an alkyl mercaptan having at least four carbon atoms, said alkyd resin being compatible with urea-formaldehyde and melamine formaldehyde resins. (USP-12)

**4.1.11.** A composition of matter comprising a compatible blend of about 10-50 parts of an aminoplast resin selected from the group consisting of melamine-aldehyde resins and urea-aldehyde resins, about 90-50 parts of an alkyd resin modified with 26%-50% by weight of a material selected from the group consisting of semi-drying glyceride oils, nondrying glyceride oils and the fatty acids derived therefrom and 0.5% to 10% by weight of a modifier comprising a polymeric alkyl ester of an alpha, beta unsaturated carboxylic acid. (USP-19)

**4.1.12.** A coating composition, capable of yielding on baking a non-cratering film, comprising a compatible blend of an alkyd resin modified with up to 25% of a material selected from the group consisting of semi-drying and nondrying glyceride oils and their acids, a butylated melamine-formaldehyde resin, and from 0.05% to 10% by weight of a polymeric alkyl ester of an alpha, beta unsaturated carboxylic acid, wherein said percentage by weight is based on the total weight of the resin solids. (USP-22)

**4.1.13.** Ester resins suitable for oleresinous varnish and printing ink formulations which are esters of natural resins of at least 75 acid value with a member of the group consisting of the monomeric monohydric phenolic ethers of aliphatic polyhydric alcohols and their epoxides. (USP-34)

**4.1.14.** The method of forming an alkyd resin comprising simultaneously esterifying and condensing an intermediate product, comprising a monomeric tetrahydrophthalic acid half ester of a monoester of a 10 to 22 carbon atom fatty acid with a polyhydric aliphatic alcohol having at least three hydroxyl groups, with an esterifying agent selected from the group consisting of a 10 to 22 carbon atom fatty acid, a natural resin acid and hydrogenation products thereof, a polycarboxylic organic acid and anhydrides thereof and polyhydric aliphatic alcohols. (USP-40)

**4.1.15.** A process for the production of an improved drying alkyd resin, comprising admixing a drying glyceride oil, modified alkyd resin with from 5 to 60 per cent of its weight of a liquid polymer comprising a polybutadiene free from solid polymers, having a viscosity at 100° F. within the limits of 100 to 10,000 Saybolt Furol seconds, a molecular weight within the limits of 500 to 4,000 and a specific gravity, 60/60° F., within the limits of 0.85 to 0.95, heating the resulting admixture of polymer and drying alkyd resin at a temperature within the limits of 450 and 600°F., whereby said polymer reacts with said alkyd resin to form said improved alkyd drying resin; and recovering said improved alkyd drying resin. (USP-68)

**4.1.16.** A process for effecting the condensation of a member of the class consisting of fumaric acid, fumaric acid anhydride, esters of fumaric acid, half esters of fumaric acid, salts of fumaric acid, salt esters of fumaric acid and amides of fumaric acid with an aliphatic, non-conjugated, polyunsaturated fatty oil which comprises admixing a member of said class with an aliphatic, non-conjugated, poly-unsaturated fatty oil, introducing from 0.1% to about 2% by weight of the mixture of a free halogen, and heating the reaction mass to a temperature within the range of from about 175° C. to 300° C. until said class member has reacted. (USP-124)

**4.1.17.** The Thibaut & Walker Co., Inc. has issued new loose leaf binder containing complete catalog of the various resins and products they manufacture. A good portion of the book is devoted to suggested formulations based on their products.

**4.1.18.** The T. F. Washburn Company has issued a loose leaf binder with technical data sheets, product data, formulations etc., relating to the alkyd and other resins manufactured by them.

**4.1.19.** The Monsanto Chemical Company has issued 90-page book on the "Chemistry and Processing of Alkyd Resins".

cf: 15.1.9
34.2.2
35.10.1
35.10.5
37.2.3
37.3.2
38.1.5
38.1.11
49.1.7

Manufacturers:
Adco Chemical Company
Alkydol
American Alkyd Industries
American Cyanamid Company
Archer-Daniels-Midland Company
Atlas Powder Company
Cargill, Inc.

Farnow Varnish Works
France, Campbell & Darling, Inc.
Freeman Chemical Corp.
General Electric Company
Hercules Powder Company
Jones-Dabney Company
McCloskey Varnish Company
Reichhold Chemicals, Inc.
Rohm and Haas Company
Schenectady Varnish Company
Fred'k. A. Stresen-Reuter, Inc.
The Thibaut & Walker Company, Inc.
T. F. Washburn Company

### Maleic

**4.2.1.** A laboratory study by Brand, et al, of the effect of amount and type of excess polyol on the cooking characteristics and film properties of a maleic-tall oil alkyd has shown that there is a marked effect on vehicle bodying rate, a noticeable effect on storage stability, and slight effect on cold-water resistance. Drying rate and adhesion appear to be essentially unaffected. Excess glycerol over the range from 0 to 25 percent and pentaerythritol from 0 to 10% were studied. Data are presented in graphic form for viscosity development and storage stability. (PVP-36)

cf: 37.2.2
Manufacturers:
Alkydol Labs., Inc.
American Cyanamid Company
Archer-Daniels-Midland Company
Cargill, Inc.
France, Campbell & Darling, Inc.
Hercules Powder Company
Rohm & Haas Company
Schenectady Varnish Company


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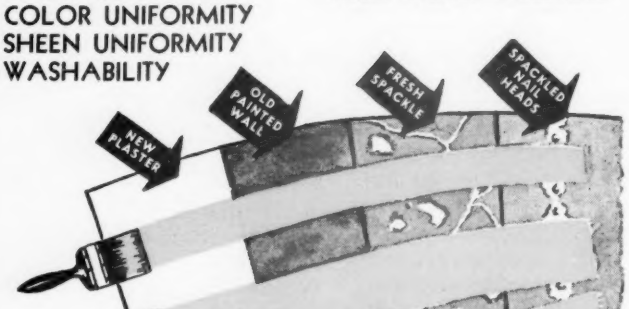


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| ACID NUMBER | 10 Maximum (on solids) |
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### Styrenated

**4.3.1.** Hempel discusses the styrenation of alkyd resins. Preparation of a styrenated alkyd may proceed by: 1. Drying oils or fatty acids are reacted with styrene, then treated with phthalic anhydride and glycerine or pentaerythritol, and 2. normally processing the oils, acids and polyols into an alkyd, then up-grading the alkyd with monostyrene. This paper details a suggested procedure for such an esterification and styrenation. (APJ-40)

**4.3.2.** Hempel describes the styrenation of alkyd resins. The largest reason for the growth of styrenated alkyds as new vehicles in surface coatings has been the ease with which alkyd resin equipment could be converted into styrenated processing equipment. Solvent resistance and mar properties of styrenated alkyds have as yet not reached maximum desired degrees, but the growth of styrenated alkyds will continue. (PIM-18)

**4.3.3.** Reichhold Chemicals, Inc. has issued Technical Bulletin SC-7 describing properties and uses of No. 4255-50 Styrasol, an oil-modified alkyd resin combined with vinyl toluene.

cf: 4.1.9
4.1.19
16.1.4
Manufacturers:
American Cyanamid Company
Jones-Dabney Company
Reichhold Chemicals, Inc.

CHAPTER 5

# CELLULOSE DERIVATIVES

## General

**5.1.1.** Immergut, Ranby & Mark describe recent work on the molecular weight of cellulose. Osmotic molecular weights and intrinsic viscosity of cellulose nitrates and cellulose nitrate fractions in several solvents have been systematically studied. By combination of these results with data on the intrinsic viscosity of the primary celluloses in cupriethylenediamine, a relation is given which permits calculation of the degree of polymerization of cellulose from intrinsic viscosity in cupriethylenediamine. Direct osmotic pressure measurements of solutions of cellulose in cupriethylenediamine were attempted, using polyvinylbutyral and sintered polytrifluorochloroethylene membranes. The shear dependence of the intrinsic viscosity of cellulose nitrates in acetone was studied and the results are presented and discussed. (IEC-9)

**5.1.2.** Martin reports on work of Cellulose Disperse Viscosity Subcommittee. A study of the solvent power and stability of cupriethylene and cuprammonium solvents as a function of the amount of copper and of base has been completed. Work is being started on the preparation of cellulose solutions in the optimum solvents and on the viscosity behavior of such solutions. The Subcommittee is considering a tentative method in which results will be reported in terms of intrinsic viscosity and/or intrinsic fluidity. Factors for converting to degree of polymerization will be included. Viscosity measurements will be made at a concentration such that the product of concentration and intrinsic viscosity equals 3.0. Preliminary data indicate excellent reproducibility at a level within 10% of the true intrinsic viscosity. This tentative method is being tested in several laboratories, but a choice of solvent should be made before a standard method is published. (IEC-11)

**5.1.3.** Immergut & Eirich survey the methods for determining molecular weight with the aid of viscosity measurements. The determination of molecular weights from viscosity data by means of calibration suffers from differences in molecular weight averages and distribution, and from variations of molecular structure. The theoretical interpretation of viscosity data depends on the applicability of the models of molecular shape and rigidity, the state of solution, concentration effects, and the influence of the rate of shear. Experimentally, there are new data concerning the variation of the exponent in the Mark-Houwink relation with molecular weight and solvent. Staudinger's equation is not a limiting law but fits intermediate cases. There is further evidence of a shear dependence of the intrinsic viscosity at high rates of shear or high molecular weights. (IEC-12)

**5.1.4.** Conrad reviews methods for measuring molecular weight uniformity of cellulose and cellulose derivatives. There has been continuous development in methods for measuring molecular weight uniformity. Fractionation methods continue to hold the center of the stage. Recent studies have shown superiority of precipitation fractionation over solution techniques and have emphasized the importance of proper choice of solvent and precipitant. The relative width of the sedimentation diagram and its change with change of distance from the center of rotation are used as a measure of polydispersity, which must be adjusted to zero concentration. New methods include electron microscopy, chromatographic adsorption, turbidity, streaming birefringence, coacervation fractionation, resinographic replica, and dielectric dispersion. Recent methods are concerned with quick approximations for securing the distribution curve, application of automatic or semiautomatic devices for tracing the curve, and improved mathematical techniques for expressing results. (IEC-13)

**5.1.5.** Mueller & Rogers discuss fractionation of cellulose through selective extraction with dilute solutions of cupriethylenediamine (Cuene). A summative method is described in which the sample size or the concentration of the cupriethylenediamine can act as parameter of variation. Only data on concentrations of cellulose and the viscosities of the extracts are required to yield a summative distribution curve, which, following the theory of Coppick and coworkers, can be expanded to the usual integral and differential distribution curves. Results compare favorably with the average of distribution curves for selected standard samples examined by several different methods in cooperating laboratories. (IEC-15)

**5.1.6.** Scott, discussing fractional separation of cellulose reaches the following conclusions. It is futile to subdivide into more than a few fractions per stage. Fractionation is sharper from more dilute solutions, but careful refractionation is more satisfactory than working at dilutions much lower

than 1 gram per liter. A combination precipitation and extraction method is superior to either alone. (IEC-17)

**5.1.7.** Cellulose literature does not exist as such—it is a part of literature of many sciences and technologies. The fact that there is no central organization to plan and prepare annotated bibliographies, together with the tremendous size of the field, accounts for the dearth of such bibliographies in cellulose chemistry. (CEN-9)

**5.1.8.** Chemical Research Activities of Buckeye Cotton Oil's cellulose and specialties division have been transferred to a new laboratory building in Memphis. This building is designed to facilitate basic and applied research on cellulose and protein and their chemical derivatives and by-products. (CEN-13)

**5.1.9.** Weaver, et al, discuss the alkylation of cellulose with esters of p-toluene-sulfonic acid. The topochemical conversion of cellulosic textiles to ethers of cellulose often confers interesting properties. Carboxymethylated fabrics are soluble in alkali, aminoethoxycellulose has the dyeing characteristics of wool, and etherification with the stearamidomethyl group produces a water-repellent textile.

Esters of p-toluenesulfonic acid have been used as alkylating agents for many types of organic compounds, but the literature contains no information concerning the preparation of ethers of cellulose with these reagents.

This preliminary work established the optimum conditions for the methylation of cellulose with methyl p-toluenesulfonate and the alkylation with other esters under these conditions. The reactivity of the p-toluenesulfonates with alkali cellulose was found to diminish as the length of the alkyl group increased. The ethyl and propyl ethers were prepared, but the butyl and phenyl esters were ineffective as etherification agents for cellulose. (IEC-62)

**5.1.10.** Millett, et al, discuss the preparation and properties of hydrocelluloses. The following experimental facts were obtained concerning the heterogeneous hydrolysis of cellulosic materials.

Hydrolysis rates remain constant throughout the hydrolysis of the entire resistant portion.

Average chain lengths decrease rapidly to a relatively low value during the initial stages of hydrolysis and decrease slowly; values of degree of polymerization at the half life are characteristic of each material.

Mercerization usually, but not always, increased hydrolysis rates.

Pulping and other procedures applied to a standard cotton have little influence on the leveling-off degree of polymerization, but they do affect the rate of hydrolysis.

Hydrolysis half-life values or hydrolysis rate constants are sensitive characteristics for differentiating wood pulps and for evaluating the influence of pulping and purification procedures.

Curves for moisture adsorption by the hydrocellulose residues as a function of extent of hydrolysis show that moisture adsorption decreases, then increases, and finally reaches a limiting value that is similar for the nine celluloses studied. (IEC-63)

**5.1.11.** Rollins reviews some aspects of microscopy in cellulose research. Included are polarized light, ultraviolet microscopy, infrared microscopy, other special techniques, phase microscopy, experimental results with cotton fibers, studies of the primary wall, winding layer, and other uses of microscopy. (AC-10)

### Cellulose Nitrate

**5.2.1.** The relationship between the viscosity of nitrocellulose and its molecular weight and degree of polymerization is discussed by Caldwell and Creasy and an empirical equation given for calculating these values from determinations of the technical viscosity of nitrocellulose solutions. The effect of the viscosity grade of the nitrocellulose on the viscosity and solids content of lacquers is shown and the development of hot-spray formulations from a consideration of the effect of temperature on nitrocellulose solutions is considered.

The tensile strength and elongation of the various grades of nitrocellulose, both unplasticized and plasticized, and in various solvents, have been determined, showing a marked falling off in the lowest viscosity grades, indicating that low-boiling solvents give greater values than high-boiling solvents.

These properties have been compared with natural weathering and cold check tests, and it has been found that the same trend is followed; the durability is independent of the nitrogen content or of the source of the cellulose whether cotton linters or woodpulp. The moisture permeability is shown to be practically independent of the viscosity and nitrogen content but is decreased by plasticizers.

The relative advantages and disadvantages of nitrocellulose made from cotton linters and dense woodpulp are indicated. (JOCCA-20)

**5.2.2.** The degree of nitration of nitrocellulose of a given molecular weight has an important effect upon the viscosity of its solutions. As complete nitration is seldom attained, this effect must be considered in determining degree of polymerization from viscosity measurements. Lindsley & Frank present an equation which makes it possible to calculate the intrinsic viscosity of any nitrocellulose, independent of the nitrogen content. (IEC-10)

**5.2.3.** Nitration and fractionation of cellulose are discussed by Roseveare & Poore. Difficulties not anticipated from the literature were encountered in the fractionation of nitrated cellulose. The results of this work show the effects of nitrating procedure on the quality of the nitrocellulose. Sources of error in fractionation and the degree of separation of one- and two-step fractionations are given. These results will help others prepare stable, undegraded nitrocelluloses and recognize some of the difficulties and limitations of fractionation in giving true degree of polymerization distributions. (IEC-14)

**5.2.4.** Mitchell presents report of Subcommittee 21, Committee on Standards and Methods of Testing, Division of Cellulose Chemistry, American Chemical Society on precipitation fractionation of cellulose nitrate. Towards selecting a method for the determination of molecular weight distribution of cellulose, 17 laboratories have applied their preferred fractionation procedures to six standard celluloses. A majority preference was shown for "precipita-

tion" fractionation of the cellulose nitrate derivative, prepared with minimum degradation. A tentative method involves: (1) conversion of the cellulose to cellulose nitrate, (2) separation into several fractions through stepwise precipitation from solution by the addition of a nonsolvent, and (3) measurement of the weight and viscosity of each recovered fraction and calculation of its average chain length. (IEC-16)

**5.2.5.** Bruxelles & Mahlman point out the complex nature of what is called glossiness in nitrocellulose lacquers and the properties of a surface that affect it. It is believed that the use of surface traces, or coating profiles, is a promising tool in the study of protective coatings. The use of such data permits an evaluation of a physical surface obtained, and this surface is probably the most important of the many independent and interrelated gloss variables.

The measurement of coating profiles has demonstrated the close surface correlation of topcoat and substrate, and points the way to improved coating design. (OD-36)

**5.2.6.** Flory, et al, studied the thermodynamics of crystallization in cellulose trinitrate. The high melting point of cellulose trinitrate is a consequence of its low entropy of fusion, and cannot be attributed to large intermolecular attractions in crystals. (JPS-24)

cf: 5.1.1
5.1.4
5.4.1
20.2.1
39.1.24
39.1.25
50.5.3

Manufacturers:
American Cyanamid Company
Hercules Powder Company
Monsanto Chemical Company

### Cellulose Acetate

**5.3.1.** Malm, et al, discuss the effect of salts in purification of cellulose prior to acetylation. Various salts in the final wash water used in the purification of cellulose affect acetylation reactivity. (IEC-43)

cf: 2.1.22
4.1.7
5.1.4
5.1.1
8.1.5
17.1.12
20.2.1
50.5.5

Manufacturers:
Eastman Chemical Products, Inc.
Hercules Powder Company

### Cellulose Acetate Butyrate

**5.4.1.** Gearhart & Ball present part II of their series on half-second cellulose acetate butyrate. The purpose of this paper is to elaborate on previously presented data on this cellulose mixed ester and to present more information about this material. The information includes a comparison of the product with other cellulose acetate butyrates, with cellulose acetate, and with cellulose nitrate; modification with plasticizers, solvents, resins, and pigments; and finally some typical formulations for lacquers and melt coatings. (OD-33)

**5.4.2.** An organic, resinous, transparent, flame-resistant, thermoplastic composition consisting essentially of 50-75% of cellulose acetate butyrate combined with 22-35% of chlorinated paraffin wax containing from 64% to 68% of chemically combined chlorine, and an organic stabilizer for said chlorinated paraffin wax to make n all substantially 100%, said stabilizer being an epoxy compound. (USP-131)

**5.4.3.** Eastman Chemical Products, Inc. has issued 24-page booklet—Technical Data on Half-Second Butyrate Lacquer. Also issued were Formulator's Notes Nos. 2-5 listing formulations for paper lacquer, clear metal lacquer, aluminum foil lacquer, and hot melt coating.

cf: 2.1.22
Manufacturer:
Eastman Chemical Products, Inc.

### Ethyl Cellulose

**5.5.1.** The Hercules Powder Company has issued 16-page brochure describing properties and use of ethyl cellulose in specialty coatings.

cf: 2.1.22
20.2.1
39.1.24
39.1.25
39.1.46

Manufacturers:
Dow Chemical Company
Hercules Powder Co.

### Carboxymethylcellulose

**5.6.1.** Dieckman, Jarrell and Voris discuss carboxymethylcellulose in the free acid form; preparation and properties of water dispersions. A water dispersion of the acid form is prepared by acidification of a water solution of sodium carboxymethylcellulose with a strong acid-type cation-exchange resin. Viscosity data for water dispersions are given. (IEC-3)

**5.6.2.** Allgen & Roswall studied dielectrically by the "ellipsoid method" at various wave lengths, a carboxymethylcellulose sodium salt (CMC) with about 50% of the glucose units substituted. Aqueous solutions containing 0.1—0.0025 g/100 ml were investigated. Dielectric increments of 2-9 dielectric constant units were obtained for these solutions. It was concluded that the dielectric properties of CMC are very similar to those of other polyelectrolytes studied—such as desoxyribonucleic acid, nucleohistone, and hyaluronic acid. (JPS-30)

**5.6.3.** Nieuwenhuis studied the improvement of the dirt suspending power of CMC. The salts of carboxymethylcellulose (CMC) are used in large quantities to improve the dirt-suspending power of synthetic detergents and soaps. Hardly any attention has been given to the question as to which properties they should have to obtain the greatest suspending power. (JPS-31)

**5.6.4.** A water-soluble plastic film consisting of 100 parts of a water-soluble salt of carboxymethylcellulose containing at least 0.3 glycollic acid residues per glucose unit of cellulose and 30-100 parts plasticizer, said plasticizer consisting of 35-65% glycerine and the balance sorbitol. (USP-83)

**5.6.5.** The Hercules Powder Company has issued 16-page booklet "Hercules CMC on Paperboard for Better Gloss Printing."

**5.6.6.** CMC-CT—new applications for technical grade sodium carboxymethyl cellulose are contained in a revised booklet from Hercules Powder Company.

Manufacturers:
Hercules Powder Company
Wyandotte Chemicals Corporation

### Methylcellulose

**5.7.** (No abstracts) American Cyanamic Co.

Manufacturer:
Dow Chemical Company

### Hydroxyethylcellulose

**5.8.1.** A new powder form of Cellosize hydroxyethylcellulose is now being offered by Carbide and Carbon Chemicals Company. It's available in two viscosity types—WPHS and WPHS Low.

Manufacturer:
Carbide & Carbon Chemicals Division

## CHAPTER 6

# EPOXY RESINS

### General

**6.1.1.** Dearborn and others studied the reaction between polyglycidyl ethers and carboxylic acid anhydrides, using the thermal yield point as the significant variable. The yield point increases with increasing anhydride content of the molding compound to a maximum which corresponds to a ratio of one mole of anhydride to one mole of epoxy-oxygen. Amines were found to accelerate the reaction markedly. A large number of compositions were investigated. Increasing the functionality of the glycidyl ether and/or that of the anhydride increases the thermal yield point. (IEC-24)

**6.1.2.** Rouse, et al, studied curing agents for epoxy resins. The study was designed to evaluate a series of cured coatings based on epoxy resins, including both air-dried and baked coatings.

Probably the best over-all coatings, based on epoxy resins, are obtained when urea or phenolic resins are used as curing agents. These systems, however, unlike those containing aliphatic amines or polyamide resins, require elevated curing temperatures.

Epoxy resin esters, cured either by oxidative or heat polymerization, provide films with good gloss and color retention as well as with flexibility and solvent resistance superior to that shown by alkyd films.

Epoxy resin compositions employing polyfunctional amines as curing agents may be either air-dried or baked. Threshold baking temperatures are low, compared to systems employing phenolic or urea resins. These compositions, cured at room temperature, are superior to alkyds and to epoxy resin esters from the points of view of solvent and chemical resistance, and hardness. They are inferior in color and gloss retention.

This study shows that polyamide resins, are highly effective for achieving cured compositions in combination with epoxy resins. Such compositions, like those containing aliphatic amines, may be cured by air-drying or by baking at low temperatures. Epoxy-polyamide compositions show better flexibility, greater impact resistance, somewhat better blush resistance, better gloss retention, and not as good initial gloss as the epoxy-aliphatic amine system. (OD-13)

**6.1.3.** "Curing Agents for Epoxy Resins" presented at the Annual Meeting of the Federation of Paint & Varnish Production Club in Atlantic City, N. J., October 29, 1953 by the Northwestern Paint & Varnish Production Club was also presented before the Northwestern Club prior to presentation at Atlantic City. This paper (previously abstracted, See 6.1.2.) was followed by an open forum discussion at the Northwestern Club. (OD-28)

**6.1.4.** Cerami reviews the epoxy resins. The growing attention being focused on the epoxy group of resin finishes is based, in large part, on their extraordinary versatility. By combining them with various materials-urea resins, phenolic resins or fatty acids, among others—a whole range of air-drying and baking vehicles can be produced. (OF-16)

**6.1.5.** Shell Chemical turns out epoxy resins at record rate; annual U.S. output may soon hit 30 million pounds. Highly flexible paints based on epoxy resins have become preferred products in the meta decorating field-coatings are applied before stamping operations. Excellent abrasion resistance has led to their increasing use for floor varnishes; resistance to chemical attack has made them a premium product for industrial maintenance coatings. (CEN-18)

**6.1.6.** Hopper reviews the uses of Epon resins in surface coatings. Epon resins can be used in three basic ways as surface coatings: (1) as heat-converted films with urea or phenolic resins, (2) as ester combinations with fatty acids, and (3) as films converted either at room temperature or elevated temperatures with chemical amines DTA, EDA, etc., or with certain amides like the polyamide resins. These three basic systems are discussed in detail. (OD-49)

**6.1.7.** Delmonte discusses the use of epoxy resins for laminated tooling. Their low shrinkage and good adhesion are solving many of the problems inherent in production and use of plastic tools in metal working industries. The author discusses the selection and use of epoxy resins, their pot life and cure, and other considerations in their use. (MM-10)

**6.1.8.** Aries discusses the use of epoxy casting resins for embedding electronic components. (MP-31)

**6.1.9.** The Northwestern Club studied curing agents for epoxy resins. Epoxy resins cure by the following five procedures:

1. Cross-linking with urea and/or melamine resins at elevated temperatures.
2. Cross-linking with phenolic resins at elevated temperatures

3. with aliphatic polyfunctional amines such as ethylene diamine and diethylene triamine
4. esterified with various vegetable oils and esters cured by oxidation
5. with monomeric acids or acid progenitors such as p-toluenesulfonic acid or phthalic anhydride

In this study all methods were included except for acid-cured systems. (POCR-8)

**6.1.10.** Seymour & Steiner discuss epoxys for cements and coatings. Although the proper role of epoxy cements is yet to be firmly set, their properties leave no doubt about their potential usefulness in corrosive applications. (CE-18)

**6.1.11.** Hopper discusses the use of Epon resins in surface coatings. These resins can be used in three basic ways, 1. as heat converted films with urea or phenolic resins, 2. as ester combinations with fatty esters, and, 3. as films converted either at room temperature or elevated temperatures with chemical amines—DTA, EDA, etc., or with certain amides like the polyamide resins. These three basic systems are discussed in detail. (APJ-72)

**6.1.12.** Jorczak & Divorkin discuss epoxy-polysulfide resins. The combination of polysulfides with epoxy resins result in flexible thermosetting plastics. High degree of impact and chemical resistance, low shrinkage, and good adhesion to metals and non-metals are major advantages. (PE-5)

**6.1.13.** Hopper discusses the use of Epon resins in surface coatings. They can be used in three basic ways as surface coatings: 1. as heat converted films with urea or phenolic resins; 2. as ester combinations with fatty acids; 3. as films converted either at room temperature or elevated temperatures with chemical amines—DTA, EDA, etc., or with certain amides like the polyamide resins. These three basic systems are discussed in detail. (POCR-33)

**6.1.14.** Hopper discusses the use of Epon Resins in surface coatings. These epoxy resins can be used as heat converted films with urea or phenolic resins, as ester combinations with fatty acids, or as films converted either at room temperature or elevated temperatures with chemical amines. (PIM-26)

**6.1.15.** The two step process of making high melting point resins and final infusible products which comprises first reacting a dihydricphenol free from reactive groups other than phenolic hydroxyl groups with an excess of an aliphatic polyepoxide free from reactive groups other than epoxide and alcoholic hydroxyl groups to form a reaction product having terminal epoxide groups and further reacting this product with a further amount of such a dihydricphenol. (USP-91)

**6.1.16.** A composition comprising an epoxidized carboxylic acid ester containing a plurality of non-terminal epoxy groups in the acyl groups thereof in admixture with glycidyl polyether of a polyhydric phenol having a 1,2-epoxy equivalency greater than 1.0. (USP-140)

**6.1.17.** The Bakelite Company has issued Technical Bulletins Nos 1-3 on Bakelite C-8 Resins:

BR-18774 high viscosity epoxy resin

BR-18795 low viscosity epoxy resin

BR-18794 relatively high viscosity epoxy resin.

**6.1.18.** Reichhold Chemicals, Inc. has issued Technical Bulletin SC-5 describing properties and uses of P-786-50 Beckosol, an ester made from an epoxy resin and dehydrated castor oil fatty acids.

**6.1.19.** The Shell Chemical Corporation has issued Bulletin SC: 54-30 "Chemical Resistant Baking Vehicle Epon Resin Formulation YP-100.

**6.1.20.** The Shell Chemical Corporation has issued Bulletin SC:54-37 #Bibliography of Magazine Articles for Epoxy Resins".

One hundred references are cited dating from 1946 to date of issue.

**6.1.21.** The Shell Chemical Corporation has issued Bulletin SC:54-47 on "The Use of Epon Resins in Adhesives Applications."

cf: 13.1.1
13.1.10
13.2.2
14.1.5
39.3.24
39.12.6

Manufacturers:
Aries Laboratories
Bakelite Company
Ciba Company, Inc.
Furane Plastics Inc.
Jones-Dabney Company
Schenectady Varnish Company
Shell Chemical Corp.

### Styrenated Epoxy Resins

**6.2.1.** Tess, et al, report on styrenated esters of bisphenol-epichlororhydrin condensates. A solvent method of styrenation allows all of the styrene to combine with the esters. The styrenated esters of bisphenol-epichlorohydrin condensates possess an unusual combination of properties that should prove useful in commercial coating applications. (IEC-39)

cf: 16.1.4

## CHAPTER 7

# HALOGEN---CONTAINING RESINS

### General

**7.1.1.** Reding & Brown studied the cause of the brittleness of polychlorotrifluoroethylene, which results when the resin is slowly cooled from the melt or heated for prolonged periods at a temperature slightly below the melting point.

The polymer chains in the spherulites of fluorothene are oriented to produce cleavage planes parallel to the spherulite radii. The spherulites form regions of weakness in the polymer. Size and perfection of spherulites are corrulated to the brittleness and voltage breakdown of the polymer. To minimize these undesirable properties, the size and perfection of the spherulites must be minimized. (IEC-84)

**7.1.2.** A liquid coating composition comprising an aqueous dispersion of polytetrafluoroethylene containing a wetting agent and an aqueous dispersion of another resinous polymerized ethylenically unsaturated material, the second mentioned aqueous dispersion and said coating composition each having the property of drying at a temperature of at least 100°C. in one coat to a crack-free film having a thickness greater than the critical cracking thickness of said aqueous dispersion of polytetrafluoroethylene alone. (USP-137)

**7.1.3.** A composition resistant to the discoloring effects of heat comprising 100 parts by weight of a halogen-containing resin and as a stabilizer therefor a mixture of 0.05 to 2 parts by weight of a zinc salt from the group consisting of zinc salts of organic acids and zinc salts of inorganic acids which give a non-acidic reaction in an aqueous medium and 1 to 10 parts by weight of a calcium chelate derivative of a 1,3-dicarbonylic compound capable of keto-enol tautomerism, the quantity of said zinc salt being smaller than the quantity of the said calcium chelate. (USP-157)

cf: 2.1.12

### Chlorinated Rubber

**7.2** (No abstracts)

cf: 39.1.24
39.1.25
49.1.7

Manufacturer:
Hercules Powder Company

### Chlorinated Polyphenyls

**7.3.** (No abstracts)

cf: 20.1.6

Manufacturer:
Monsanto Chemical Company

### Chlorinated Paraffin

**7.4.** (No abstracts)

Manufacturers:
Diamond Alkali Company
Hercules Powder Company

## CHAPTER 8

# HYDROCARBON RESINS

### General

**8.1.1.** Snyder, et al, describe a technique for the separation of substantial quantities of the labile trans-1-cyano-1, 3-butadiene from its cis isomer. Melting point data and infrared spectra determinations have confirmed the assignments of configeration previously given to these isomers. The cis compound copolymerized with butadiene about 2.5 times more rapidly than the trans isomer. When various mixtures of the isomeric cyanodienes were copolymerized with butadiene, it was found that at any given percentage conversion, the composition of the copolymer was independent of the cis-trans ratio in the monomer charge. Moreover, the geometrical configurations and elastomeric properties of copolymers from the two isomers were practically identical. It was concluded that both isomers have identical monomer reactivity ratios with butadiene, but that inhibitors of copolymerization were engendered during copolymerizations involving the trans isomer. The Diels-Alder adducts of the trans isomer with itself and with butadiene were shown to be powerful polymerization inhibitors. (JACS-1)

**8.1.2.** Melalia and Freedman determined the configuration of polybutadienes prepared at high temperatures. Solution polymerization of butadiene-1,3 was carried out at various temperatures, using propylene carbonate as solvent and di-t-butyl peroxide as initiator. The polymers were dissolved in carbon disulfide and analyzed for cis, trans and 1, 2-addition by infrared absorption. The instrument was calibrated using reference standards of polybutadiene prepared at 5 and 97°. As the temperature was increased beyond 100°, the % cis increased very gradually and finally leveled off to a constant value, of about 30% cis over the temperature range 180 to 270°. (JACS-3)

**8.1.3.** Krigbaum and Flory present the evaluation of thermodynamic interaction parameters from dilute solution measurements. This is part V of Statistical Mechanics of Dilute Polymer Solutions. Accurate osmotic pressure measurements are reported for benzene solutions of four well-fractionated polyisobutylene samples, varying in molecular weight from 102,000 to 720,000, at three temperatures in the vicinity of the $\Theta$ temperature at which the second virial coefficient in the expansion of the osmotic pressure vanishes. As evaluated from these data, $\Theta = 297.5°$ K., independent of the molecular weight. The entropy of dilution parameter $\Psi$, calculated from the change in the second virial coefficient with temperature at $T = \Theta$, is $0.34 \pm 0.02$. (JACS-8)

**8.1.4.** Naylor & Anderson studied the thermal stability of copolymers of $SO_2$ with ethylene, propylene, butene-2, isobutene and butadiene. Degradation of all but butadiene $SO_2$ follow first-order kinetics to a first approximation at 200° or above. (JACS-69)

**8.1.5.** Leeper & Schlesinger studied the interconversion of alpha and beta forms of gutta polyisoprene obtained from chicle. The gutta isolated from chicle was shown to be structurally identical with the trans-polyisoprene from gutta percha and balata but has a molecular weight of 16,000-18,000, about half of that of the latter two polymers. The $\alpha$- and $\beta$-forms of chicle gutta were prepared and studied. (JPS-3)

**8.1.6.** Having a structure very similar to natural rubber, new resin (Solarite Resin #11) blends easily with both natural and synthetic rubbers, maintaining flexibility even after severe aging. (CE-9)

**8.1.7.** Bisschops studied the reversible gelation of concentrated polyacrylonitrile solutions, by creep measurements under constant shearing stress at different stages of the reaction. The rate of gelation increased strongly as the temperature decreased. The gelation is ascribed to the formation of a tri-dimensional network. The crosslinks are assumed to be crystallization nuclei. (JPS-44)

**8.1.8.** A water-insoluble resin containing a plurality of sulfonic acid groups, said groups being attached to an insoluble, infusible resin prepared by the polymerization of a polymerizable mass comprising a polymerizable aryl acetylene hydrocarbon compound. (USP-5)

**8.1.9.** A new composition of matter adapted to be formed into shaped articles, comprising at least 5 percent of an acrylonitrile polymer containing, by weight in the polymer molecule, at least 80 percent of acrylonitrile, an organic solvent for the polymer, and from 0.1 to 5.0 percent based on the weight of the organic solvent of an inorganic acid salt of an organic amine selected from the group consisting of hydroxylamine hydrochloride, dimethylamine hydrochloride, phenylhydrazine hydrochloride, and aniline sulfate. (USP-101)

**8.1.10.** A process for the preparation of a resinous polymer which comprises mixing butadiene, isobutylene and toluene in a ratio of 60/20/20, diluting the mixture with methyl chloride, cooling the diluted solution to a temperature between 0° C. and—40°C., adding thereto 10% by weight based on the feed of aluminum chloride catalyst dissolved in ethyl chloride in a concentration between 0.1 and 5% and separating the resulting resin from the reaction mixture. (USP-117)

**8.1.11.** A new synthetic rubber processing resin is now being made by Solar Compounds Corp. Known as Solarite Resin No. 11, it's a synthetic hydrocarbon resin.

cf: 18.1.12
50.1.1

Manufacturers:
Advance Solvents & Chemical Corp.
American Mineral Spirits Company
The R. J. Brown Company
Enjay Company, Inc.
Neville Chemical Company
Pan American Chemicals
Pennsylvania Industrial Chemical Corp.
Petroleum Specialties Company
Solar Compounds Corp.
Velsicol Corp.

The Goodyear Tire & Rubber Co., Inc.
Indoil Chemical Company
Nova Chemical Corp.
Oronite Chemical Co.
Thiokol Corp.

### Coumarone-Indene

**8.2.** (No abstracts)

Manufacturers:
Barrett Division
Neville Chemical Company.
Pennsylvania Industrial Chemical Corp.

### Petroleum Hydrocarbon

**8.3.1.** Panek, et al, discuss air drying polysulfide rubber paint films. These films have a unique property, namely a negative coefficient of electrical resistance versus elongation. (POCR-10)

**8.3.2.** The Pennsylvania Industrial Chemical Corporation has issued 4-page bulletin on properties and uses of Transphalt, a series of dark thermoplastic resins.

**8.3.3.** The Petroleum Specialties Company has issued 10-page technical bulletin describing properties and uses of Petro-Resins #76, 90, and 100, polymerized olefin hydrocarbons.

cf: 50.3.3

### Terpenes

**8.4.** (No abstracts)

Manufacturers
Hercules Powder Company
Pennsylvania Industrial Chemical Corp.

### Butadiene-Styrene Resins

**8.5.1.** The polybutadienes and butadiene-styrene copolymers were prepared by Binder, to study the effect of recipe variables on the physical properties and to learn whether there are correlations between the microstructures and physical properties. The changes in microstructure of emulsion polybutadienes and butadiene-styrene copolymers of the types studied, which can be produced by either recipe variables or changes in temperature, are limited. (IEC-79)

**8.5.2.** Polson discusses styrene butadiene copolymers in the paint industry. The styrene-butadiene copolymer resins have been proven excellent paint vehicles. In the United States they have received recognition as standard raw materials of the paint industry. Paints based on them may be readily formulated and produced in equipment now existing in paint factories. The paints produced have outstanding resistance to chemicals and have been shown to possess excellent exterior durability. The technology of the formulation and manufacture of these paints is well developed. Markets for these paints are growing and present markets

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AB 11-2 AD 6-3 AB 11-4 AD-21 AD-4

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Foreign Division
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have not yet been fully exploited. (OD-47)

**8.5.3.** Goodyear's technique for synthetic resins now successfully developed to plant scale. Unique process removes water, during butadiene-styrene polymer production, without evaporation or mechanical means. Done by syneresis, ie; sweating or squeezing out of the solvent as a separate phase from a thixotropic gel. (CE-23)

**8.5.4.** The Goodyear Chemical Division has issued a revised copy of 16-page brochure Stucco Finishes made with Pliolite S-5, butadiene-styrene resin.

**8.5.5.** The Marbon Corporation has issued a loose leaf binder with ten technical reports on the properties and use of Marbon 9200, a styrene copolymer resin.

Manufacturers:
Dewey & Almy Chemical Company
The Goodyear Tire & Rubber Co., Inc.
Marbon Corp.
West Virginia Pulp & Paper Company

**Asphalt And Other Bitumens**

**8.6.1** Shearon & Hoiberg discuss the air-blowing of asphalts and catalyst additions to modify blown asphalts. Catalyst addition, as for example phosphorus pentoxide, prior to blowing results in modified blown asphalts having greater flexibility at low temperatures and increased resistance to flow at high temperatures. Product characteristics vary with quantity of catalyst and blowing time. (IEC-1)

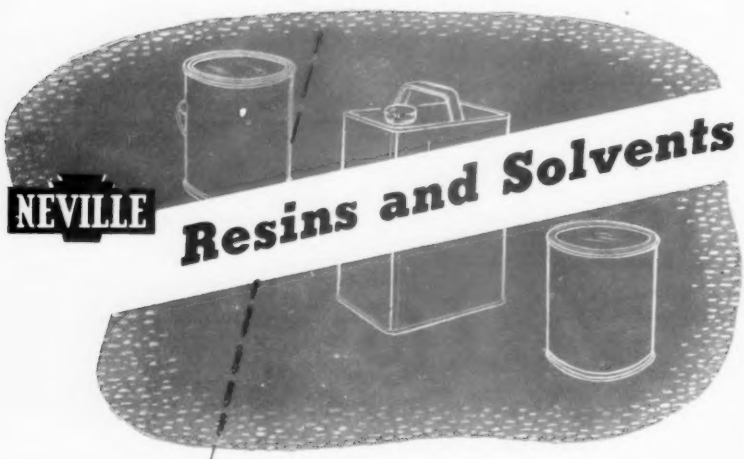
**8.6.2** Greenfeld discusses accelerated tests on three asphalts, representative of the major sources of coating asphalt used in the manufacture of prepared roofings in the United States. Thermal shock tests were compared with "Weather-Ometer" tests. (ASTM-2)

**8.6.3** Greenfeld describes the use of a hydraulic press to the preparation of uniform films of both stabilized and unstabilized bitumens for exposure out of doors and to accelerated durability tests. Films in the range of 0.005 to 0.050 in. were made consistently with a maximum variation of ±0.001 in. in more than 90% of the cases. Coatings up to 0.100 in. thick can also be made. (ASTM-3)

**8.6.4** Kleinschmidt describes a method for the preparation of test coatings by spinning of asphalts, coal-tar pitches, and other solid materials not having fixed melting points, and which will liquify under 450°F. The method was most effective where a series of coatings was required varying by small increments in thickness. Coatings have been prepared by this method from blown petroleum asphalts in thicknesses ranging from 0.0005 to 0.05 in. (ASTM-4)

**8.6.5.** Salomon, et al, have adapted the method of van Heurn and Begheyn, to the estimation of rubber in asphalt. As a corollary to the growing tendency to add elastomers to bitumen and asphalt, a method by which these polymers can be estimated quantitatively in mixtures is needed. The rubber is extracted with xylene or higher boiling solvents. The rubber in this soluble portion then reacts with a large quantity of sulfur and the rubber content is determined from a sulfur analysis of the purified ebonite. (AC-17)

**8.6.6.** A self extinguishing asphalt composition comprising a mixture of asphalt, chlorinated paraffin in the range 5-40%, and antimony oxide in the range of 5-40%, the combined weight of the chlorinated paraffin and antimony oxide being in the range of 25%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*Plants at Neville Island, Pa., and Anaheim, Cal.*

P-52

to 100% of the asphalt, the chlorinated paraffin being at least 50% chlorinated, and the balance being substantially inorganic filler. (USP-30)

cf: 30.12

Allied Asphalt & Mineral Corp.
Anderson-Prichard Oil Company
Barber Asphalt Corp.
Barrett Division
Newport Industries, Inc.
Pennsylvania Industrial Chemical Corp.
G. S. Ziegler & Company

**Butadiene-Acrylonitrile Resins**

**8.7.1.** The reactions of acrylonitrile and butadiene in the temperature region of 400° and atmospheric pressure are reported by Janz and Duncan. In the uncatalyzed reaction, cyanocylohexene only is formed, but in the presence of a chroma-alumina catalyst, vinyl-pyridine and cyanocyclohexene are obtained. (JACS-9)

**8.7.2.** A composition of matter comprising 30 to 60 parts of a resin prepared by condensing formaldehyde with an aliphatically substituted phenol having as its only substituent a $C_{10}$ to $C_{21}$ hydrocarbon side chain selected from the group consisting of alkyl radicals, mono-olefinic radicals and diolefinic radicals; in combination with 70 to 40 parts of a solid rubbery copolymer of 20 to 35 percent of acrylonitrile and 80 to 65 percent of butadiene-1, 3, the resin having been incorporated in the copolymer while the resin was in a fusible state. (USP-49)

## CHAPTER 9

# NITROGEN---CONTAINING RESINS

### General

**9.1.1.** Heiss, et al, studied the reactions of a 100% excess of diisocyanates with various glycols and polyols, and subsequent curing with water, to show the usefulness of the resulting polymers.

Very promising polyurethan-ureas were prepared from 2, 4-tolulene diisocyanate or 4,4¹diph-enylmethane diisocyanate and a large number of polyols. The adhesion to metals, glass, and several plastics was good. Film properties could be varied over a wide range, depending on the type of polyol used. The polymers could also be used to prepare foamed resins.

Preliminary work indicates that diisocyanate-glycol reaction products, like the diisocyanate-modified polyesters, may be valuable in adhesives, coatings, films, and foams. (IEC-64)

**9.1.2.** Wolff, et al, describe the preparation of partially substituted starch carbamates both in anhydrous pyridine and in aqueous medium. Gelatinization-resistant starches result when as little as one hexamethylenecarbamly cross-link for each 500 anhydroglucose units is introduced. (JACS-33)

**9.1.3.** A process for the preparation of a hydrocarbon solvent soluble resinous material comprising heat-reacting tall oil with an aldehyde-reactable resin forming polyamino compound, adding an aldehyde and heat-reacting the mixture to form a resinous material. (USP-3)

**9.1.4.** A composition of matter comprising a compatible mixture of 5-40% by weight of a thermosetting alcohol-modified aminoplast resin and 95-60% by weight of a thermoplastic copolymer of (1) an hydroxy alkyl ester of an alpha beta ethylenically unsaturated carboxylic acid and (2) a compound containing a $CH_2=C<$ group, wherein the ratio of (1):(2) on a mol percent basis is 5:95-50:50, respectively, wherein the hydroxy group of (1) is a part of a $-CH_2OH$ group and compound (2) is devoid of any hydroxy group wherein said aminoplast resin is the condensation product of an aldehyde and a compound selected from the group consisting of urea, melamine, dicyandiamide, formoquanamine, benzoguanamine, ammeline, 2-chloro-4, 6-diamino-1, 3,5-triazine, 2-phenyl-p-oxy-4, 6-diamino-1, 3,5-triazine,6-methyl-2,4-diamino-1,3, 5-triazine,2,4,6-trihydrazine-1,3,5-triazine, 2,4,6-triethyl-triamino-1,3,5-triazine, and 2,4,6-triphenyl triamino-1,3,5-triazine. (USP-139)

**9.1.5.** A cross-linked polymer which is the product obtained by reacting, at a temperature of 25 to 200°C., a polymeric polyprimary amine having a molecular weight of at least 1000 and a main carbon chain with at least three extracatenic primary amino nitrogen groups thereon, with at least 0.5 mole, per primary amino group in said polymeric polyprimary amine, of a member selected from the class consisting of diaryl carbonates and diaryl thiocarbonates. (USP-145)

cf: 3.1.2
18.1.2

### Melamine-Formaldehyde

**9.2.1.** Wohnsiedler discusses polymerization in melamine-formaldehyde resins. This reaction belongs to the type producing polymers by condensation. In prevailing theory the typical polymer derived from polyfunctional, other than bifunctional, reactants is visualized as a highly branched, chain structure or network having growth in three dimensions and having a small number of intramolecular linkages. Actually only a fraction of functional groups in, for example, a trifunctional reaction is required to form such a network. (IEC-6)

**9.2.2.** A process of producing melamine which comprises heating in a pressure resistant vessel urea and ammonium sulfate in amounts up to and including about 10 mol percent of ammonium sulfate based on the urea taken and maintaining the thus heated materials at temperatures between about 300° C. and about 400° C. and under high pressure until substantial quantities of melamine are present in the reaction mixture, and recovering from said reaction mixture melamine thus produced. (USP-25)

**9.2.3.** In a process for the production of melamine by heating urea, exposed to a chrome-nickel stainless steel surface, to elevated temperatures under superatmospheric pressures to decompose the urea with formation of melamine and in addition thereto, ammonia and carbon dioxide as gaseous pyrolysis products of the urea, the improvement which consists in introducing into the reaction zone ammonia from an external source in amounts in the range between about 0.2 and about 1 mol per mol of urea introduced therein, maintaining reaction temperatures at about 300° C., and developing total pressures in the gas phase in contact with said

reaction mixture of at least about 300 atmospheres and at most about 350 atmospheres. (USP-156)

cf: 17.8

Manufacturers:

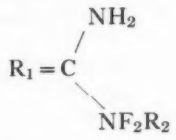
American Cyanamid Company

Monsanto Chemical Company

Rohm & Haas Company

### Urea-Formaldehyde

**9.3.1.** A process for the production of a water soluble urea-aldehyde resinous product which comprises heating at least one compound of the general formula



in which $R_1$ is selected from the group consisting of oxygen, sulfur and nitrogen, and $R_2$ and $R_3$ are selected from the group consisting of hydrogen, alkyl, alkenyl, aryl, acyl radicals of saturated acids and acyl radicals of unsaturated acids in the presence of water and an ammonia compound selected from the group consisting of ammonia and alkyl, oxalkyl and hydroxyl substituted ammonia in a proportion of 1 mole of the component of the above general formula to 0.01 to 0.5 mole of the ammonia compound, thereafter adding at least one aldehyde to the reaction product and condensing the reaction product with such aldehyde, only at a pH below 7. (USP-29)

**9.3.2.** A method of producing a thermosetting resin capable of imparting superior wet strength to paper that comprises bringing together a ureaformaldehyde reaction product of less than the desired viscosity, wherein the molar ratio of urea to formaldehyde is from 1:1.9 to 1:3.0, and from 0.01 to 0.2 mol per mol of urea of a water-soluble salt of an ethylenepolyamine having not more than four ethylene groups in aqueous solution at a pH above 4, and then carrying out condensation by maintaining the solution at a pH above 4 and below 6 and heating at a temperature from 70 degrees C. to the boiling point to effect viscosity increase. (USP-149)

**9.3.3.** The Borden Company (Chemical Division) has issued Bulletin PS-105a on Casco-Resin PR-165; Wet Strength Resin for Paper.

**9.3.4.** Reichhold Chemicals, Inc. has issued Technical Bulletins SC-3 and SC-4 describing properties and uses of No. 3530 Beckamine and No. 3535 Beckamine, two new aromatic solvent soluble, urea-formaldehyde resins.

Manufacturers:

American Cyanamid Company

Bakelite Company

The Borden Company

Jones-Dabney Company

Monsanto Chemical Company

Reichhold Chemicals, Inc.

Rohm & Haas Company

Synvar Corporation

### Protein Resins

**9.4.** (No abstracts)

Manufacturers:

The Borden Company
Corn Products Sales Company
General Mills, Inc.
Hercules Powder Company

### Polyurethanes

**9.5.1.** The short history of isocyanates in the U. S. chemical industry is tied most closely to two names: DuPont and Monsanto. Both are in the spotlight: Dupont, for its new Adiprene B urethane rubber, now undergoing field tests; Monsanto, for a string of new isocyanate and diisocyanate process patents. (CW-20)

**9.5.2.** Bjorksten, et al, review the polyurethane resins with the emphasis being directed to developments subsequent to 1947. 154 references are cited. (MP-23)

**9.5.3.** Dyer & Bartels, have prepared, new polyurethans by the reaction of methylenebis-(4-phenyl isocyanate) and hexamethyl-diisocyanate with various branched 1,3-diols and with two dihydric phenols. The polyurethans made from aliphatic diols were unaffected by 1% NaOH at 50°, whereas the polyurethans from phenols were attacked. Quantitative determinations were made of the hydrolysis products, which included carbon dioxide, the diamine, the phenol and a polyurea. The polyurea was shown to result from the action of the diamine on unchanged polyurethan. (JACS-30)

cf: 9.1.1
37.6.7
39.12.3

Manufacturers:
Monsanto Chemical Company

## CHAPTER 10

# NATURAL RESINS

### General

**10.1.1.** Wood pulpers have more lignin than they know what to do with. They dump or burn most of it, but there's plenty of reason to believe this by-product deserves a better fate. (CE-24)

cf: 50.2.2

Manufacturers:

Arthur-Daniels-Midland Company
Delou, Inc.
Frazier, Campbell & Darling, Inc.
O. C. Innes Corp.
Morningstar, Nicol, Inc.
U. S. Industrial Chemicals,cIn.

### Dammar

**10.2.** (No abstracts)

cf: 50.2.2

### Shellac

**10.3.1.** The Acme Shellac Products Company has issued a copy of a report by Foster D. Snell, Inc. on the Comparative Evaluation of Three Lacquer Mixing Shellacs.

**10.3.2.** Gillespie-Rogers-Pyatt Company, Inc., has issued 5-page bulletin describing properties and uses of G-R-P White French Varnishes composed of pure shellac.

Manufacturers:

Acme Shellac Products Company
Delou, Inc.
Gillespie-Rogers-Pyatt Company, Inc.

### Guar Seed

**10.4.** (No abstracts)

Manufacturers:

The Burtonite Company
Stein, Hall & Co., Inc.

## CHAPTER 11

# POLYAMIDES

### General

**11.1.1.** Feuer & Pier studied the acid-catalyzed reaction of formaldehyde with dinitriles to produce polyamides and specifically, the effect of centers of decreasing basicity in the nitrile. It was found that dinitriles containing basic centers failed to polymerize with formaldehyde. (JACS-22)

**11.1.2.** Peerman, et al, discuss polyamide resin coatings. Polyamide resins are versatile condensation polymers similar to nylon. They have inherently high impact resistance, flexibility, adhesion and gloss. They have excellent resistance to both water and grease. "Polyamide Resin 100" is a reactive polymer used to cross-link epoxy-type resins. Combinations of "Polyamide Resin 100" and epoxy resins are thermosetting and have the attractive properties of good flexibility, strong adhesion and high impact resistance. (OF-21)

**11.1.3.** Gustavson has investigated the irreversible fixation of vegetable tannins by collagen and esterified collagen, as well as by a hydrated polyamide. The polyamide possesses a marked affinity for the vegetable tannins and binds them irreversibly. (JPS-32)

**11.1.4.** A process for producing synthetic linear polyamides which comprises reacting an organic dinitrile of the formula: NC—$R'_m$—CN wherein R' is a divalent radical from the group consisting of hydrocarbon and unreactive heterocyclic radicals and *m* is a numeral from 0 to 1 and an N,N'-dimethylolamide of the formula

HO—$CH_2$—NH—CO—R—CO—NH—$CH_2$—OH

wherein R is a divalent radical from the group consisting of hydrocarbon, unsubstituted heterocyclic, and halogen-substituted hydrocarbon and heterocyclic radicals, in the presence of a strong acid catalyst as the reaction medium, the concentration of the organic dinitrile and N, N'-dimethylolamide together constituting from 2 to 40% by weight of the reaction mixture, and continuing the reaction until a polymer of the desired intrinsic viscosity is obtained. (USP-61)

**11.1.5.** A composition of matter suitable for use in the formulation of clear and pigmented coating compositions comprising a mixture of (*a*) polymeric amide solution consisting essentially of a mixture of (1) a solution of a polymeric amide of an alkylene diamine of from 2 to 6 carbon atoms and a polybasic saturated aliphatic acid of from 2 to 8 carbon atoms in an aqueous solution of a water soluble aliphatic alcohol and containing from 10% to 20% solids and (2) a stabilizer solution amounting to from 5% to 30% by weight of the polymeric amide solution, said stabilizer being a normally liquid halogenated saturated aliphatic hydrocarbon of from 1 to 7 carbon atoms and containing a plurality of halogen atoms; and (*b*) a 40% —60% aqueous solution of a partially cured, acid curing phenol aldehyde resin, said components (*a*) and (*b*) being in intermixture in a weight ratio of from 40:60 to 60:40, respectively, calculated as the solutions. (USP-70)

**11.1.6.** A cross-linked polyamide which is the product obtained by reacting a diester of oxalic acid with a polymeric polyprimary amine having a molecular weight in excess of 1000 and having a main chain consisting solely of carbon atoms with at least three extracatenic primary amino nitrogens each directly attached by a single bond to the main carbon chain, said polymeric polyprimary amine being the product obtained by the reductive amination with ammonia and hydrogen of a copolymer of ethylene and carbon monoxide. (USP-144)

**11.1.7.** General Mills, Inc. has issued a 4-page Technical Bulletin 11-1-2, describing properties and uses of polyamide resins 90, 93, 94, 95, 100, and 115.

cf: 2.1.1

Manufacturers:
E. I. duPont de Nemours & Co., Inc.
General Mills, Inc.
Nopco Chemical Company

CHAPTER 12

# POLYETHYLENE AND MODIFIED POLYETHYLENE

### General

**12.1.1.** Lawton, et al, describe the properties of irradiated polyethylene. Polyethylene is cross-linked when irradiated with high energy electrons. The physical properties of irradiated polyethylene were measured to determine the magnitude of the changes brought about by this irradiation. Irradiation produces a cross-linked product having improved physical properties and high temperature characteristics over those of the original material. (IEC-78)

**12.1.2.** Bowers, et al, investigated the static and kinetic frictional properties of a group of unplasticized linear high polymers and copolymers, using a Bowden-Leben "stick-slip" machine. The polymers were derivatives of polyethylene containing various proportions of fluorine or chlorine. The substitution of chlorine for hydrogen in polyethylene caused an increase in friction, and that the substitution of fluorine caused a decrease. The affect of chlorine was found to predominate when both chlorine and fluorine were substituted. (MP-14)

**12.1.3.** Higgons describes the use of a thermally sensitive blowing agent to produce cellular polyethylene by extrusion. (MP-16)

**12.1.4.** Wall, et al, studied depolymerization rates and molecular weight changes of polymethylene and mass spectrometric analyses of the volatile products obtained. The results are compared with those for commercial and radiation cross-linked polyethylene. Cross linking has little effect on the rate of depolymerization. (JACS-63)

**12.1.5.** Campbell discusses the irradiation of polyethylene. The properties are briefly discussed. (MM-11)

**12.1.6.** Baccaredda & Schiavinato measured refractive indices of polythenes by the immersion method in suitable liquid mixtures. Refractive index measurement may be suitable for the determination of the degree of branching and of the degree of crystallinity in polythenes and other polymeric substances. (JPS-29)

**12.1.7.** A method of coating surfaces with polyethylene having a melting point of at least 105° C. and a viscosity at 190° of at least 25,000 poises, which comprises applying to the surface to be coated a powdered mixture of such polyethylene and from 20% to 200%, based on the weight of the polyethylene, of a volatile solvent material of the class consisting of hydrocarbons and chlorinated hydrocarbons having a boiling point of 150° to 300° C. and which dissolves polyethylene at temperatures above 120° C., and baking the material coated with said mixture at temperatures of 120° to 230° C. but below the atmospheric boiling point of the solvent material until substantially all of the solvent is removed. (USP-72)

**12.1.8.** The General Electric Company has issued a 4-page data sheet describing the properties and uses of GE Irrathene 101, irradiated polyethylene.

cf: 50.1.14

### Polyethylene

**12.2.1.** A new explanation of polyethylene's physical and mechanical behavior has been pieced together by a team of DuPont research chemists. The key seems to be short-chain branching. It starts when the terminal carbon atom of a growing polymer chain snakes back to grab a hydrogen atom already held by another carbon in the chain. For an instant both carbon atoms share the hydrogen, forming a ring that quickly breaks when the terminal carbon takes complete possession of the hydrogen. A new long chain grows when other ethylene molecules hook on at the site vacated by the hydrogen leaving a short branch made up of the three or four carbons that were in the ring. (*CW-12*)

**12.2.2.** Tordella & Jolly describe the measurement of the melt index of polyethylene with a simple extrusion plastometer. The measurement has proved reliable, rapid, and convenient. Only minor instrument maintenance has been required over a period of more than three years. The combination of high precision plus the economy and ease of operation have made this method of measuring melt flow most satisfactory. (MP-4)

**12.2.3.** Roedel studied chain branching in polyethylene during polymerization. Two types of branching can occur during the free radical polymerization of ethylene. These two types depend upon different polymerization variables and effect different physical properties of the formed polymer. Long chain branching is due to intermolecular hydrogen transfer, is dependent upon polymer concentration, and mainly affects rheological properties. Short chain branching is believed to be due to intramolecular hydrogen transfer via transient ring formation, is dependent upon polymerization temperature, and mainly affects properties in the crystalline state. (JACS-15)

**12.2.4.** Bryant and Voter determined short chain branching in polyethylene by infrared studies. The following conclusions were reached: (1) No appreciable number of pendant methyl side chains are present. The methyl and ethyl groups are parts of longer chains most of which are believed to contain four carbons. (2) Methyl groups in unfractionated polyethylenes studied range from 0.2 to 4.6 per hundred carbon atoms. (3) Predominance of short chains over long chains tend to a larger crystallite size and a degree of crystallinity in better accord with X-ray results. The general structural picture of the polymer has been revised to conform with these findings. (JACS-16)

**12.2.5.** A new method for the quantitative estimation of chain branching is developed by Billmeyer and applied to polyethylenes. The light scattering molecular weight and intrinsic viscosity of a branched polymer are compared with those calculated for a linear but otherwise identical sample. The method is sensitive only to long branches. Some polyethylenes have from 4 to 34 such branches per molecule, on a weight-average basis. Their molecular weight distributions are extremely broad; weight-to-number average molecular weight ratios as high as 20:1 are often found. Experiments with fractionated polyethylenes confirm these conclusions. (JACS--17)

**12.2.6.** Beasley calculates the number and distribution of long chain branches, together with detailed molecular weight distribution functions from kinetic equations describing the process of radical transfer to polymer. The presence of branching causes the molecular weight distribution to be broadened with the appearance of a long high molecular "tail" on the distribution curve. (JACS-18)

**12.2.7.** Sperati, et al, show that various properties of polyethylene resins are controlled by combinations of the independent structural parameters of short chain branching, long chain branching and molecular weight. Stiffness, yield point, melting point and sorption of reagents are controlled primarily by crystallinity as affected by short chain branching and measured by density. Ultimate elongation, Vicat temperature and hardness are controlled by both density and melt viscosity (measuring molecular weight). Finally, the viscoelastic properties of the molten polymer and the ultimate strength of the solid are controlled by molecular weight and the amount long chain branching. Equations representing the relationship between these variables are presented, and an explanation is given for apparent anomalies in the literature. (JACS-19)

**12.2.8.** Wiese describes a new process for the flame-spraying of polyethylene to porous or non-porous surfaces and which does not degrade the plastic. For porous surfaces, the system includes application of a resin sizing, a coating of a resin cement, an intermediate layer of a mixture of silicon dioxide and polyethylene, and an outer layer of flame-sprayed pure polyethylene; for non-porous surfaces, the sizing operation is omitted. (MP-13)

**12.2.9.** Twenty million pounds of A-C Polyethylene—that's the estimated annual production of the new Niagara River Petrochemical Plant (Tonawanda, N. Y.) of Allied's Semet-Sovay Petrochemical Division.

This is the first plant for commercial production of ethylene from any petroleum or natural gas fraction heavier than air. The adjoining polymer plant processes the ethylene into polyethylene.

Uses include—paper processessors can, because of narrow melting range and viscosity characteristics, incorporate the polymer into petroleum waxes at lower formulation costs.

Rubber, paint, textiles, printing inks, electrical insulations—manufacturers who need non-tacky, nontoxic polymers with high chemical and abrasive resistant qualities. (CE-12)

**12.2.10.** The Semet-Solvay Petrochemical Division has issued a 2-page bulletin describing properties and uses of emulsifiable A-C polyethylenes.

**12.2.11.** The Semet-Solvay Petrochemical Division has issued bulletins SSP-I-101, SSP-I-103, #2, #3, and #4 describing the properties, uses, and compatibility of AC Polyethylenes.

cf: 2.1.1
2.1.22
18.1.2
29.2.8

Manufacturers:
Bakelite Company
E. I. duPont de Nemours & Co., Inc.
Semet-Solvay Petrochemical Division

### Halogenated Polyethylene

**12.3.1.** Amborski & Flierl discuss polyethylene terephthalate films. This polymer possesses a high melting point and good resistance to hydrolytic degradation. Mechanical, thermal, electrical and optical properties as well as permeability and chemical resistance are discussed. (IEC-4)

**12.3.2.** Smook, et al, studied infrared spectra to follow the reactions of chlorosulfonated polyethylene with amines, alcohols, and inorganic bases. The sensitivity of the molecule to water during these reactions was demonstrated, and the effect of heat on the stability of the sulfonyl chloride group was shown.

A clear picture of the mechanism of some of the cross-linking reactions of chlorosulfonated polyethylene can be obtained from this work. (IEC-27)

**12.3.3.** Polyethylene can be improved by bombarding with high energy electrons from modified X-ray equipment. This article gives a complete description of the process being developed by the Chemical Division of the General Electric Company to treat molded and extruded polyethylene. (MP-20)

**12.3.4.** Izard describes the success story of polyethylene terephthalate. The major applications so far have been as a fiber, film, or photographic film base. Its many properties make it interesting for use in coatings. (CEN-25)

**12.3.5.** Thomas made an exploratory investigation of the kinetics of the polymerization of chlorotrifluorethylene. Experiments were conducted in bulk, in solution in several solvents, and in the presence of several comonomers. Acetyl peroxide was found to be the most affective of common initiators and was used in most of the experiments. The sealed ampoule technique was employed. (JPS-11)

**12.3.6.** Hagemeyer & Stubblebine studied the physiological activity of fluorocarbon polymers. Tests were conducted using bacteria and mice. Vapors generated upon heating these polymers are highly toxic. (MP-32)

**12.3.7.** Busse & Billmeyer discuss gelation reactions of chlorosulfonated polyethylene solutions. A gelation test has been developed permitting chemicals to be screened rapidly for activity in crosslinking polymers in solution. Chlorosulfonated polyethylene can react as follows:

1. with primary aliphatic amines at low temperature to form sulfonamide links
2. with primary aliphatic amines at higher temperatures by removal of chlorine from the chain and formation of crosslinks
3. with tertury amines, urea, $NH_4OH$, etc., by unidentified mechanism
4. with rubber vulcanization accelerators by reactions not involving the sulfonyl chloride group but activated by it
5. with sulfuric acid and potassium hydroxide. (JPS-45)

**12.3.8.** The Bakelite Company has issued 15-page booklet on Fluorothene Resins—Properties, Forms, Fabrication.

cf: 2.1.1
18.1.2
18.3.1

Manufacturers:
Bakelite Company
E. I. duPont de Nemours & Co., Inc.
The M. W. Kellogg Company

## CHAPTER 13

# PHENOLICS

### General

**13.1.1.** Harris, et al, describe the modification of intermediate phenol-formaldehyde condensation products (resols) by means of epichlorohydrin. In this modification the epoxy groups of the reagent are not consumed in the process under proper conditions, but are available for further reaction with other materials such as organic acids, amines, and phenols. The degree to which the phenolic hydroxyls are blocked may be widely varied. With complete conversion, resins having excellent color, alkali resistance, and flexibility are obtained. (MP-15)

**13.1.2.** Bender presents the hardening rates of known intermediate products in the phenolic resin field reacted with "hexa." A surprising reversal of ortho and para effects is found in one section of the data. The relative importance of the known structural variables in phenolic resins is compared to their hexa-hardening rates. (MP-17)

**13.1.3.** Freeman & Lewis present a kinetic study of the alkaline-catalyzed reactions of HCHO and the methylols of phenol. Previous attempts to analyze the kinetics of the phenol-formaldehyde reactions have been limited to determination of a cumulative overall reaction rate. By means of paper chromatography it is now possible to follow quantitatively the appearance and disappearance of each individual methylolphenol in the reaction system. Mathematical analysis of the data from separate experiments involving phenol, p-hydroxybenzyl alcohol, saligenin, 2,4-dimethylol- and 2,6-dimethylolphenol, respectively, with HCHO at 30°, has provided individual rate constants for the reaction of each phenolic compound. (JACS-46)

**13.1.4.** A process for the production of a synthetic varnish resin which consists of copolymerizing a vinyl compound selected from the group consisting of ortho, meta and para-vinyl phenol, their methyl, ethyl and propyl nuclear substituted homologues having at least one reactive hydrogen atom attached directly to the nucleus and a mixture of styrene with such phenol, with a drying oil selected from the group consisting of tung-oil, dehydrated castor oil, oiticiac oil and linseed oil in the absence of oxygen, and interrupting the copolymerisation prior to gelation and adding a volatile aromatic hydrocarbon solvent for the resin. (USP-14)

**31.1.5.** A liquid, low acid number ester of an oil-insoluble phenol formaldehyde resin substantially free from methylol groups, said resin containing an average of from about 4 to about 10 phenolic groups per molecule and being derived from the acid catalyzed condensation of from 2 to 2½ moles of formaldehyde per 4 moles of phenol and being substantially free from phenol and bisphenols, the hydroxyl groups of the resin being esterified at least about 60% by means of an unsaturated higher fatty acid having at least semi-drying characteristics, said ester being substantially free from acetyl groups. (USP-21)

**13.1.6.** A composition comprising a liquid, water-insoluble condensation product of phenol and formaldehyde, which condensation product is in amount sufficient, when hardened, to set the entire composition to a rigid, solid mass, and a minor amount of a hardening agent consisting essentially of a mixture of trichloroacetic acid and benzene sulfonyl chloride containing from 33 to 98 per cent by weight of the latter. (USP-42)

**13.1.7.** As a novel resin the condensation product of furacrolein, furfural and formaldehyde, the mol ratio of furacrolein to furfural being between about 1 to 1 and about 10 to 1, and the mol ratio of furacrolein plus furfural to formaldehyde being between about 0.5 to 1 and about 1.6 to 1. (USP-63)

**13.1.8.** A continuous process for preparing novolaks of the phenol-formaldehyde condensation product type comprising the steps of continuously introducing into a first reaction vessel a phenol selected from the group consisting of monohydroxybenzene, cresol, xylenol and resorcinol, a catalyst, and formaldehyde in an amount less than that required to completely react the phenol to phenol-formaldehyde and sufficient to maintain a stationary reaction condition in said first vessel, continuously withdrawing from the first reaction vessel a stream equal in volume to the streams of the reaction components entering the first reaction vessel, continuously introducing into a second reaction vessel the stream being withdrawn from the first reaction vessel, introducing a stream of formaldehyde into said second vessel in an amount sufficient to continue the reaction of the phenol without gelatinizing the reaction mixture, and successively repeating the steps of continuously introducing reaction mixture, adding a quantity of formaldehyde to the reaction mixture to continue the reaction without gelatinization and withdrawing an amount equal in volume to that introduced in

succeeding reaction vessels until the reaction is completed. (USP-73)

13.1.9. A process for the production of a resin which comprises, condensing a polymeric material with an aldehyde selected from the group consisting of formaldehyde and compounds forming formaldehyde under the reaction conditions, acetaldehyde, butyraldehyde and furfuraldehyde, said polymeric material having in its molecular structure polymer units selected from the group consisting of ortho, meta and para vinyl phenol polymer units. (USP-88)

13.1.10. Polyhydric phenol-epoxide compositions consisting essentially of poly-epoxides free from reactive groups other than epoxide and alcoholic hydroxyl groups and polyhydric phenol polyether alcohols having terminal phenolic and intermediate alcoholic hydroxyl groups and being free from reactive groups other than hydroxyl groups. (USP-89)

13.1.11. The method which comprises mixing from about 0.25 to 2.50% by weight of fluoboric acid in aqueous solution with cashew nut shell liquid and heating the mixture. (USP-94)

13.1.12. A composition capable of hardening rapidly in the cold to yield chemically resistant masses, comprising an inert filler, a hardening agent, a still liquid resin obtained by condensing formaldehyde and phenol in the molecular proportion ranging from about 1:1 to about 1.8:1 in an alkaline medium; a compound selected from the group consisting of diethyl sulfate, dipropyl sulfate, dibenzyl sulfate, triethyl phosphate, 1,3-dichloropropanol, epichlorhydrin, dichlorhydrin, ethylene chlorohydrin, said compound being present in an amount ranging from about 5 per cent to about 25 per cent, calculated upon the amount of the resin used; and furfurol in an amount ranging from about 10 per cent to about 90 per cent, calculated upon the amount of the resin used. (USP-103)

13.1.13. A water soluble phenolic resin comprising the reaction product of phenolic material containing a phenol having a distillation range between 180 and 220° C. and not containing more than about 15% of at least one phenol selected from the group consisting of ortho cresol, xylenol and mixtures thereof and an alkaline redwood bark extract powder, and aqueous formaldehyde in the presence of an alkali metal hydroxide. (USP-112)

13.1.14. A phenol-formaldehyde resin with 80% to 100% of the hydroxyl groups esterified by means of a mixture of unsaturated higher fatty acids containing from 8-18 carbon atoms and a benzoic acid selected from the group consisting of benzoic acid and hydrocarbon substituted benzoic acids, from 5% to 20% of the total esterified hydroxyl groups being esterified with a benzoic acid. (USP-114)

13.1.15. The Bakelite Company has developed a new fast-curing phenolic plastic, BMG-5000.

cf: 8.7.2
15.1.9
39.1.4
49.1.7
50.5.1

Manufacturers:
Adco Chemical Company
Alkydol Labs., Inc.
Archer-Daniels-Midland Company
Bakelite Company
Durez Plastics & Chemicals, Inc.
France, Campbell & Darling, Inc.
General Electric Company
Hercules Powder Company
Krumbhaar Chemicals Inc.
McCloskey Varnish Company
Monsanto Chemical Company
Neville Chemical Company

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Snyder Chemical Corporation
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The Thibaut & Walker Co., Inc.
U. S. Industrial Chemicals, Inc.
T. F. Washburn Company

### Phenol-Formaldehyde

**13.2.1.** Sofer, et al, studied the use of ultrasonic wave propagation to follow the reaction of phenol with formaldehyde. The strong dependence of ultrasonic propagation parameters on the extent of cure of phenolic molding resins suggests that they may be used as criteria for the extent of polymerization of phenolic and other thermosetting molding resins. The technique seems capable of providing useful indication of the rate of cure. (IEC-29)

**13.2.2.** The modification of various intermediate phenol-formaldehyde condensation products (resols) by means of 1,2 epoxides is described by Harris, et al. Epoxide addition occurs at the most highly ionized position of the molecule and catalyzed by alkalies through the production of phenolate ions. The progressive conversion of phenol groups to ether linkages reduces the thermosetting properties of the resin and, with complete conversion, produces a stable product—a polyhydric alcohol. Esterification of these alcohols with organic acids results in a variety of products ranging in properties from plasticizers to materials which harden by air-drying or heat conversion. (MP-11)

cf: 50.5.1

CHAPTER 14

# ROSIN AND ROSIN DERIVATIVES

### General

**14.1.1.** Svetlik & Hanmer describe the rosin acid extension of high Mooney rubbers. (IEC-31)

**14.1.2.** Johnson reviews products derived from pine trees. These derivatives of the pine tree have served us from ancient times but their greatest value may just be coming.

Wood rosin, of itself, finds very little use in the form of a solution in solvents, as it tends to crystallize out in concentrations exceeding 20% rosin. Rosin is modified by treatment with lime, hydrogenation, conversion to alcohol (hydroabietyl), and conversion to amine.

Another important derivative of the pine tree is tall oil which is finding increased use as a source of cheap fatty acids for production of alkyd resins. (CPVM-4)

**14.1.3.** St. Clair, et al, describe a method for the preparation of fused resinates from aldehyde-modified rosin. The fused metal resinates are clear, homogeneous, noncrystalline, and have good stability in the common varnish solvents. When modified with aldehydes, rosin derivatives of low acid numbers, such as decarboxylated rosin and rosin esters, can be reacted with the acetates of cobalt and manganese to give hydrocarbon soluble resins that may contain as many as two moles of metal per mole of rosin derivative. (IEC-85)

**14.1.4.** Laws discusses crude pine gum oleoresin, and the production and processing of it into gum rosin and turpentine. The gum naval stores industry is the oldest continuously operated industry in existence in America today. People have been predicting its end but to despite its ups and downs it continues to flourish and will continue to do so as long as we have pine trees. (APJ-10)

**14.1.5.** Austin & Drew describe epoxy modified rosin esters and their use in lacquers and varnishes. Eplex 14, Eplex 15, and Eplex 16 are discussed. These are epoxy-rosin esters manufactured by Crosby Chemicals, Inc.

Preliminary results indicate superior performance of these resins in lacquers, varnishes and vehicles. (POCR-30)

**14.1.6.** Laws discusses the production and processing of crude pine gum oleoresin into gum rosin and turpentine. (PIM-2)

**14.1.7.** Stinson & Lawrence studied the effect of heat on gum rosin. The temperature range included 155° to 200° C. Moderate heating for shorter periods of time brings about an increase in softening point, a more negative optical rotation, a slight decrease in acid number, and an increase in its tendency to crystallize; higher temperatures or prolonged heating at moderate temperatures cause an opposite trend in most of these changes. (IEC-54)

**14.1.8.** The Hercules Powder Company has issued 28-page brochure describing how Vinsol Resin as a modifier of phenolic resins lowers costs and improves properties.

**14.1.9.** The Hercules Powder Company has issued 32-page brochure describing properties and uses of Vinsol Resin for Adhesives.

cf: 39.2.8
50.2.2

Manufacturers:
American Cyanamid Company
Hercules Powder Company
Newport Industries, Inc.

### Ester Gum

**14.2.1.** Hind, et al, discuss the preparation of ester gum by esterification of rosin with glycerol. The physical properties of the product can be significantly altered by varying the proportions of rosin and glycerol and by the use of catalysts. Zinc oxide is a very efficient catalyst.

The combined use of sulfur dioxide as a bleaching agent and zinc oxide as catalyst and blowing the product with superheated steam to remove volatile oils constitute a potentially practical process improvement whereby higher melting, light-colored ester gums can be made in much shorter time. (IEC-41)

Manufacturer:
Reichhold Chemicals, Inc.

## CHAPTER 15

# SILICONES

### General

**15.1.1** Kerr & Hobbs describe methods for reacting starch and starch products with substituted silanes and the properties of these starch derivatives. Three general types of products were obtained. Soluble polymers were obtained by reacting starch with monofunctional substituted silanes and with substituted silanes containing only one highly reactive substituent such as a chloro- or a small, n-alkoxy group. These starch derivatives at higher levels of derivatization were soluble in liquid hydrocarbons such as hexane or xylene. Thermosetting resins, which lost their solvent solubility with heating and time, were formed by reacting starch with bifunctional substituted silanes in which there was considerable difference in reactivity between the substituent groups attached to silicon. Insoluble cross-linked polymers resulted when starch was reacted with substituted silanes having at least two highly reactive groups. Stability of the siloxy linkage to starch appeared to increase with the size and to vary with the configuration of the other substituent groups attached to the silicon. (IEC-18)

**15.1.2** Young & Dickerman report on dielectric constants of dimethylsilicones. The dielectric constant varies smoothly with temperature over the temperature range investigated. The temperature coefficient is negative. (IEC-37)

**15.1.3** Kather & Torkelson report on sodium methylsiliconate, a silicone useful for imparting water repellency to a variety of materials. Stable, dilute, neutral solutions can be made by adding aluminum nitrate to the siliconate. The new silicone may be applied to the surface of a material or employed in integral mix. Data are presented to demonstrate effectiveness when applied to paper, brick, cement, limestone, gypsum, and casein and alkyd resin paints. (IEC-38)

**15.1.4.** Introduction of organosilylmetallic reagent could revolutionize organosilicon synthesis. It has been found possible to cleave hexaphenyldisilane and other hexaaryldisilanes in ethylene glycol dimethylether with potassium, sodium, or lithium, so that a whole spectrum of organosilylmetallic reagents is now available. (CEN-8)

**15.1.5.** Krane discusses the various applications of the silicones. In recent years paint technologists have had occasion to use silicone additives in various places in the manufacture of paint. Silicones eliminate foam in varnish kettles, prevent flooding and silking of pigmented coatings, added to bake-on enamels give an added slickness and mar-resistance to the finished article. As vehicles they produce heat resistant finishes. The protective coatings industry has found uses for silicone resins on the basis of:

1. high temperature resistance
2. high degree of water repellency
3. resistance to weathering

(CPVM-5)

**15.1.6.** Hyde, et al, prepared sodium salts of dimethylphenyl-, methyldiphenyl-, and triphenylsilanols, in high yields by the action of NaOH on the corresponding disiloxanes in alcohol solutions. These salts are readily converted to the silanols by mild hydrolysis. (JACS-12)

**15.1.7.** Fluorinated organosilanes in which the perfluoroalkyl group is separated from the silicon atom by an ethylene group have been prepared (Pierce, et al) by reaction of the Grignard reagent of 3,3,4,4,5,5,5,—heptafluoro—1—bromopentane and silicon tetrachloride or ethyl silicate. The bromide was prepared by dehydration of 3,3,4,4,5,5,5,—heptafluoro—2—pentanol followed by the addition of hydrogen bromide to the olefin in the presence of activated carbon. A silanol, silanediol and disiloxane were prepared from the fluorinated silanes as well as silicone oils. (JACS-13)

**15.1.8.** Hurd, et al, discuss the mechanism of the polymerization of polydimethylsiloxanes with strong bases. This mechanism involves 1) entry of the catalyst molecule into the siloxane system and 2) the continued action of the catalyst molecule, or some part of it, in the reshuffling of siloxane linkages. A study of the base-catalyzed polymerization of dimethylsiloxanes at room temperature in homogeneous alcoholic systems is also discussed. The nature of the silicon-oxygen-alkali metal bond has been investigated. (JACS-25)

**15.1.9.** Hedlund discusses recent developments in silicone coating resins. These resins are grouped as follows:

1. Heat resistant straight silicone resins
2. Heat resistant silicone-alkyd resins for blending
3. Silicone-alkyds for varnishes, paints and lacquers
4. Silicone-phenolics
5. Special silicone resins
6. Masonry water repellents

(OD-39)

**15.1.10.** Osthoff & Grubb determined thermodynamic proper-

ties of octamethylcyclotetrasilane. True melting point is 17.65°. Vapor pressure of the liquid obeys the equation:

$$\log_{10} p = 45.7216 - (4530.2/T) - 12.3508 \log_{10} T.$$

Enthalpy of vaporization follows:

$$\Delta H_v = 20.7 - 0.0245\ T \text{ kcal. mole}^{-1}$$

The polymer-solvent interaction parameter, $\mu$, has a mean value of 0.48 for this system. (JACS-28)

**15.1.11.** Sommer, et al, have found three new examples of intramolecular rearrangement of alkyl from silicon to carbon, thereby demonstrating the generality of this phenomenon for organosilicon compounds. (JACS-35)

**15.1.12.** Sommer & Tyler report that steric effects of the t-butyl group have made possible the synthesis of a new class of organosilicon compounds, dialkyldiaminosilanes. Silanediols containing a t-butyl group are extremely resistant toward condensation in comparison with ordinary dialkylsilanediols. (JACS-36)

**15.1.13.** Sommer & Pioch report that the use of $Me_3SiCH_2CH_2CO$ Me and $Me_3SiCH_2CH_2CO$ Et as starting materials in a variety of condensation reactions has permitted the synthesis of a number of new silicon-containing carbonyl compounds which include $\beta$-diketones and their copper chelates, $\beta$-ketoesters, cyclic $\alpha,\beta$-unsaturated ketones, pyrazolones, a $\delta$-diketone and a furoic ester. (JACS-40)

**15.1.14.** The malonic ester synthesis has been successfully applied (Sommer, et al) in the preparation of four mono-substituted malonates containing the following organosilicon groups: $Me_3SiCH_2$-, $C_6H_5Me_2SiCH_2$, $Me_3SiCH_2SiCH_2$- and $Me_3SiCH_2CH_2CH_2$-. Trimethylsilylmethyl derivatives of glutaric and barbituric acid, a disiloxanetetracarboxylic acid and a disilaheptanoic acid are described. (JACS-41)

**15.1.15.** Sommer, et al, describe the synthesis of certain vinylsilanes and substituted vinylsilanes. The reactions of vinyltrimethylsilane with hydrogen bromide, hydrogen iodide, bromine, chlorine, ozone and butyraldehyde have been studied. (JACS-42)

**15.1.16.** Sommer, et al, describe the synthesis of seven new compounds having the trimethylsilylmethyl group directly linked to silicon. It is concluded that in reactions involving the attack of bulky reagents, the steric effects of trimethylsilylmethyl are of a magnitude intermediate between the n-alkyl and t-butyl groups. (JACS-43)

**15.1.17.** Mills & MacKenzie have developed the following set of silicon bond parachors, using the system of organic parachors developed by Vogel and co-workers as a basis:

| | | |
|---|---|---|
| Si-C: | 11.8 | (no F,O, or Cl bonded to Si) |
| | 9.2 | (C is aryl) |
| | 12.6 | (one O or up to 3 Cl's bonded to Si) |
| | 14.2 | (2 O's bonded to Si) |
| Si-O: | 12.7 | |
| Si-Cl: | 60.3 | |
| Si-I: | 107.9 | |
| Si-H: | 25.0 | (No F,O, or Cl bonded to Si) |
| | 29.1 | (1 to 3 O's or Cl's bonded to Si) |
| C-C: | 3.0 | (SiEt or SiPr except $SiR_4$ cpd.) |
| | 2.3 | ($SiEt_4$ and $SiPr_4$) |
| | 2.6 | (SiOEt or SiOPr) |
| C-O: | 16.0 | (SiOR) |

(JACS-52)

**15.1.18.** Reilly, et al, have obtained electric moments for the completely substituted methyl-, ethyl-, and phenylbromosilanes, for the partially substituted phenylbromosilanes and for p-methoxyphenyl-tribromosilane. (JACS-58)

**15.1.19.** Bond & Brockway have applied the sector-microphotometer method to the electron diffraction study of mono-, di- and trimethylsilane. The results are summarized. (JACS-59)

**15.1.20.** Grubb describes a method for measuring the rates of silanol condensation rates. The method consists of a titration of samples of the reacting solutions with Karl Fischer reagent. The titration measures the total content of SiOH groups plus $H_2O$ in the solution. Complete condensation of a silanol solution results in a reduction of the apparent water concentration to one-half of its initial value. (JACS-60)

**15.1.21.** Cooper obtained organosilicon sulfides of the type $SiCH_2SR$ by the reaction of the corresponding chlorosubstituted silane or siloxane with sodium mercaptides. The corresponding sulfones may be prepared by oxidizing the sulfides with $H_2O_2$ in acetic acid, if siloxane bonds are not present; the sulfone derivatives of the siloxanes were obtained when monoperphthalic acid in ether is used as the oxidizing agent. The sulfones underwent silicon-carbon cleavage very readily when treated with bases, but were much more resistant than the corresponding ketones, esters, and nitriles to cleavage by acids. The siloxanes were much more susceptible to silicone-carbon cleavage than the silanes. (JACS-64)

**15.1.22.** White & Rochow have investigated the reactions of silane with ethylene, acetylene and vinylsilane in a system which circulated the gaseous reactants continuously through the reaction zone. Ethylene and silane at 450-510° produced ethylsilane, diethylsilane and smaller quantities of disilane, trisilane and a compound believed to be ethyldisilane. Acetylene and silane at 460-510° gave a small amount of vinylsilane, but the bulk of the product consisted of ethynylsilane, particularly ethynyldivinylsilane. With photochemical activation, the principle products were ethylsilane, n-butylsilane and 1,4-disilylbutane from silane and ethylene, and vinylsilane from silane and acetylene. (JACS-68)

**15.1.23.** Three new silicone resins are available. Resin 2106 offers high strength. Resin 2104 offers high temperature resistance. Resin 2105 is especially suited for electrical insulation. (MM-9)

**15.1.24.** Weyer & Hoffman describe heat-resistant silicone foams. The resins are expanded in four basic steps: melting the resin, blending the reagents, expanding the mixture, and curing the foam. (MP-26)

**15.1.25.** Stapleton discusses silicone paint resins. Silicones are a new class of polymers. Polymers used for paints are usually linear high polymers or relatively low polymers with the ability to convert to a larger polymer by application of heat or absorption of oxygen (by air-drying). The use of silicones in paints makes use of one or more of the following outstanding properties of silicones:

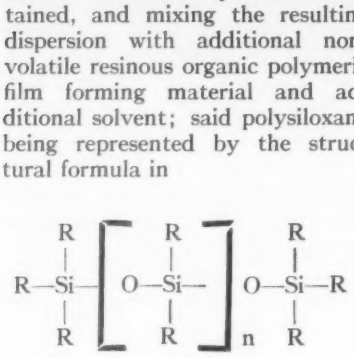
1. resistance to heat
2. color retention
3. gloss retention

4. corrosion resistance
5. weathering resistance
6. chemical resistance
(PIM-9)

**15.1.26.** A resinous composition of matter comprising a polymerizable monovalent hydrocarbon-substituted polysiloxane wherein the hydrocarbon radicals consist of both (a) vinyl radicals, and (b) monovalent radicals selected from the class consisting of alkyl and aryl radicals, all the aforementioned hydrocarbon radicals being present in the ratio of from 1.2 to 1.8 total hydrocarbon radicals per silicon atom and are directly attached to the polysiloxane silicon atoms by carbon-silicon linkages, the said vinyl radicals comprising from 1 to 20 per cent of the total number of silicon-bonded hydrocarbon radicals. (USP-8)

**15.1.27.** The process for producing solvent-soluble silicone resins from alkylsilicon halides which comprises reacting ethanol with an alkylsilicon halide containing at least two halogen atoms per silicon atom, in an amount insufficient to effect replacement of all of the halogen atoms of said silicon halide, whereby a part only of said halogen atoms are replaced by ethoxy radicals, then partially hydrolyzing the reaction product with water in the absence of a water immiscible solvent, adding a solvent for the reaction product, which solvent is immiscible with water, and then interacting the reaction product in the resulting solution with water in amount sufficient to completely hydrolyze all remaining halogen atoms and alkoxy radicals and in amount sufficient to form a separate water layer, and separating the water layer from the siloxane solution so produced. (USP-16)

**15.1.28.** The process of increasing the gloss of abrasion resistant enamels and lacquers containing polymerized ethylene which comprises preparing a gel containlng 5% to 50% of polymerized ethylene based on the weight of the gel, .025% to 2.0% of a liquid alkyl polysiloxane based on the weight of the polymerized ethylene, and a solvent for the polymerized ethylene and polysiloxane, grinding said gel with pigment, non-volatile resinous organic polymeric film forming material, and volatile solvent until a uniform dispersion is obtained, and mixing the resulting dispersion with additional non-volatile resinous organic polymeric film forming material and additional solvent; said polysiloxane being represented by the structural formula in



which the various "R's" represent monovalent alkyl hydrocarbon radicals and "$n$" is a whole number greater than one; and said polymerized ethylene being solid at room temperature, having a structural formula characterized by recurrent — $CH_2$ — groups, and showing a crystalline structure by X-ray diffraction. (USP-41)

**15.1.29.** The method for the production of siloxanes which contain substituents of the group consisting of alkoxy, aryloxy and acyloxy which comprises maintaining

$$R_mH_nSiO_{\frac{4-m-n}{2}}$$

(1) a siloxane of the average general formula in which R represents hydrocarbon radicals free of aliphatic unsaturation, $m$ has a value of from 1 to 2, inclusive, and $n$ has a positive value up to and including 1, and (2) a reactant of the group consisting of alcohols, phenols and carboxy acids in contact with an ansolvo acid, whereby a substituent of the group consisting of alkoxy, aryloxy, and acyloxy is substituted for the hydrogen of said siloxane with the liberation of free hydrogen. (USP-59)

**15.1.30.** A liquid composition comprising a lower alkoxy silane characterized only carbon-oxygen-silicon linkages, and a small proportion of an organic base having a pKa value greater than 7 and selected from the class consisting of alicyclic and saturated aliphatic organic bases having a carbon atom content of from 2 to 12 carbon atoms per molecule and having only carbon, hydrogen, oxygen and nitrogen atoms in the molecule. (USP-62)

**15.1.31.** The method which includes the steps of partially depolymerizing a solid polydimethylsiloxane elastomer to form a viscous liquid, filtering the material while in the liquid state to remove non-silicone solids present in the elastomer, and repolymerizing the material to form a modified solid polydimethylsiloxane, said depolymerization being accomplished by subjecting the solid elastomer at approximately room temperature to an essentially anhydrous acid chosen from the class consisting of hydrochloric acid, hydrobromic acid, hydriodic acid, thionyl chloride, acetyl chloride, benzoyl chloride and phthalyl chloride. (USP-107)

**15.1.32.** A composition that produces superior coatings upon hydrolysis comprising (1) a silane whose molecule consists of a silicon atom to which are attached four monovalent radicals from one to two of which are ethyl and from two to three of which are hydrolyzable radicals; and (2) a silane whose molecule consists of a silicon atom to which are attached four monovalent radicals not more than one of which is an alkyl radical having from one to two carbon atoms; from two to three of which are hydrolyzable radicals; and one of which is a saturated cycloaliphatic hydrocarbon radical having a single nucleus containing from five to six carbon atoms each of which is connected to at least one hydrogen atom, having from five to eleven carbon atoms, and having not more than three side chains containing a total of no more than five carbon atoms, the molar ratio of (1) to (2) ranging from 2:3 to 9:1, and the ratio $r$/Si ranging from 1.1 to 1.7, wherein $r$ is the total number of non-hydrolyzable radicals attached to silicon and Si is the total number of silicon atoms. (USP-128)

**15.1.33.** The Dow Corning Corporation has issued Bulletins #1-200 and #1-201 describing Dow Corning 400 Gum, a clear, high molecular weight, high viscosity, dimethyl silicone polymer. Bulletin #1-201 describes its use in compounding silicone rubber.

**15.1.34.** The Dow Corning Corporation has issued Bulletin #1-202 describing Dow Corning 410 Gum.

**15.1.35.** The Dow Corning Corporation has issued Bulletin #7-100 on silicone-based protective coatings. Performance and applications are described for straight-silicone paints, modified silicone finishes, air-drying modified silicone finishes, and silicone fluid additives.

**15.1.36.** The Dow Corning Corporation has issued Bulletin #8-300a describing properties and applications of Dow Corning Resin 129G, used for waterproofing masonry.

**15.1.37.** The Dow Corning Corporation has issued Bulletin #10-231 describing properties and applications of Dow Corning 2106 Resin, low pressure silicone laminating resin.

**15.1.38.** The General Electric Company has issued product data sheets on SR-111 silicone resin, and Dri-Film 103 silicone resin.

cf: 39.1.40
39.1.42
39.3.10
39.7.1
50.5.1
50.10.1

Manufacturers:
Dow Corning Corporation
General Electric Company
Schenectady Varnish Company

## CHAPTER 16

# STYRENES

### General

**16.1.1.** Pollock & Davis discuss five procedures for the preparation of 2, 5—Dichlorostyrene. (IEC-21)

**16.1.2.** Kut has shown that when sorbic acid is reacted with styrene by refluxing in a xylene solution, a free radical copolymerization of the monomers occurs simultaneously with the formation of a low molecular weight cyclic product. The latter has been identified as 3-methyl-1, 2, 3, 6—tetrahydrodiphenyl—6—carboxylic acid formed by Diels-Alder addition. It is suggested that the copolymerization of these two monomers proceeds through a 1,4 addition of the styrene to the conjugated (diene) system of the sorbic acid. To account for the formation of only one of the two possible Diels-Alder adducts polar attraction between the reactants, is suggested. (PVP-14)

**16.1.3.** In this third and concluding article by Kut on the reaction between styrene and unsaturated fatty acids, a study is made of the reaction between styrene and the more complex doubly conjugated $\beta$—elaeostearic acid as typical of the wood oil-styrene reaction. (PVP-22)

**16.1.4.** Swann developed two procedures for determining the polystyrene in styrenated resins. A quantitative method for determining polystyrene was needed for quality control and acceptance of quick-drying styrene-modified alkyd resins. The styrenated epoxy resins were investigated because of their related modification and their possible future interest to the Ordnance Dept. One method is applicable to either the alkyd or epoxy resins. The other, applicable to alkyds only, allows the subsequent determination of the oil acid content of the alkyd resin. Composition requirements of styrenated alkyds can be established and analytical control exercised. The extent to which monomer styrene is converted to polystyrene in the preparation of styrenated resins and oils can be determined. (AC-1)

**16.1.5.** When styrene polymerization is initiated by moderate concentrations of active monoradical-producing catalysts, the rate of initiation of polymer chains can be measured by the rate of consumption of the inhibitors. However the rate of consumption during thermal polymerization of highly purified styrene is very much greater than the rate of initiation of polymer chains. Russell and Tobolsky suggest that diradicals undergo self-termination to form small rings. While the rate of production of diradicals is very much greater than the rate of initiation of polymer chains, the actual weight fraction of the rings formed should be very small. A relation between the production of diradicals and the formation of high molecular weight polymer has not been established. (JACS-5)

**16.1.6.** Morgan measured the fluorescence bands of styrene vapor. The structure of the spectrum undergoes no change when the vapor pressure is varied from 2 to 0.06 mm., nor is any change observed in the presence of an inert gas. Polystyrene was identified as a reaction product. (JACS-6)

**16.1.7.** Shultz & Flory have obtained phase equilibria data for three ternary solvent-solvent-polystyrene systems and have interpreted these data in terms of the statistical-thermodynamic theory of polymer solution. Thermodynamic interaction parameters calculated from the observed plait points are consistent with those calculated for solvent-solvent and solvent-polymer pairs from binary system liquid-vapor and liquid-liquid phase equilibria data. (JACS-14)

**16.1.8.** Mayo studied the rate and degree of the thermal polymerization of styrene at 60, 155 and 176° in bromobenzene as solvent, with styrene concentrations from 7.6 to 0.05M. Low molecular weight, saturated, probably cyclic material and higher molecular weight, unsaturated polystyrene seem to be formed in independent reactions, and have been partially separated by precipitation of the higher polymer with methanol. Data on boiling points and unsaturation of dimer and trimer fractions are presented.

There is now no evidence for, and considerable evidence against, any participation of biradicals in the formation of high polymer from styrene. Certain aromatic solvents participate in the chain transfer with the monomer. Two mechanisms for this process are proposed which correlate observations in other polymer and non-polymer reactions. (JACS-20)

**16.1.9.** Reinforcement of styrene as is done with other thermoset plastics is now possible. Glass-reinforced polystyrene maintains its impact strength over a wide range of temperatures. It is about as strong at sub-zero temperatures as at normal room temperatures. (MP-21)

**16.1.10.** Wiley, et al, prepared and studied the polymerization of potassium p-vinylbenzenesulfonate.

It has been polymerized to high viscositie for these polymers are nonlinear functions of concentration and show a marked increase as the concentration decreases. (JACS-32)

**16.1.11.** Weisgerber & Dyer polymerized erythryl dilinoleate with styrene to give low yields of linear soluble polymers. Limiting viscosity numbers varied from 7.6 to 12.6. The ester did not homopolymerize to high polymers. Polymers containing more than 12 mole percent of the ester were crosslinked by heat treatment. (JACS-44)

**16.1.12.** Good insulation qualities, high strength-to-weight ratio, and relatively good toughness are the properties of a new expandable polystyrene available. (MM-6)

**16.1.13.** Ziegler discusses crazing in polystyrene parts. He describes briefly the results of a recent test program designed to eliminate some of the unknowns in the crazing of polystyrene. A new crazing test is presented. (MM-7)

**16.1.14.** Horikx & Hermans applied the steady state method to the benzoyl peroxide initiated polymerization of styrene in toluene at 80°C. The theory that the time needed to reach the steady state concentrations with an accuracy of 1% or better is about seven times the average time which the mixture spends in the reaction vessel, is confirmed by experiment. The rate of polymerization can be represented by:

$-dm/dt = kmE^{1/2}; E = \beta m(1+\beta m)^{-1}$

where m is the monomer concentration; k and $\beta$ are constants. $\beta = 1.19$ liter/mole.

The apparent order of the reaction, with respect to monomer, increases from 1.18 when $m = 1.8$ mole/liter to 1.36 when $m = 0.4$ mole/liter. Numerous data from the literature concerning the polymerization of styrene and other monomers are discussed and are found to be in good agreement with the conclusions reached in the present work. Explanations are offered for a number of discrepancies found in the literature. (JPS-4)

**16.1.15.** Jellinek & Turner studied the thermal degradation of polystyrene in naphthalene solutions in high vacuum. Rates of loss of weight were determined over range 350-38[illegible]°C., and the energy of activation was derived. Decrease in intrinsic viscosity with time and loss of weight as function of polymer concentrations were investigated. The mechanism of degradation in naphthalene solution is similar to that of thermal bulk degradation; an initial random chain scission (due to weak links) followed by a reverse polymerization process with chain end initiation. (JPS-5)

**16.1.16.** Hobden & Jellinek determined the rates of adsorption from solution on to charcoal and adsorption isotherms for unfractionated and fractionated polystyrene samples. Rates and extent of adsorption increase with decreasing solvent power and decreasing molecular weight. The rate curves of the fractionated samples show two distinct steps. Langmuir's adsorption equation is obeyed. Mechanisms of adsorption are discussed. (JPS-6)

**16.1.17.** Kapur determined the chain transfer constants of twelve solvents for the peroxide catalyzed polymerization of styrene and are compared, where possible, with those for methyl methacrylate. The values found are discussed in relation to structure and activity. (JPS-8)

**16.1.18.** Madorsky studied the rates and activated energies of thermal degradation of styrene and acrylate polymers. These included:

poly-meta-methylstyrene
poly-alpha-deuterostyrene
poly-alpha-methylstyrene
hydrogenated polystyrene
two methyl methacrylates
one methyl acrylate.

The styrene polymers, except hydrogenated polystyrene, degrade thermally chiefly into monomeric type molecules. In the case of hydrogenated polystyrene, breaks in the chain occur at random, the same as in polystyrene.

Polymethyl methacrylate, like the styrene polymers, breaks mostly at the radical chain ends, yielding the monomer. Polymethyl acrylate follows a mechanism of random breaking of the chains. (JPS-13)

**16.1.19.** Charlesby measured the solubility of polystyrene in benzene and toluene as a function of degree of crosslinking. Polystyrene can be crosslinked by exposure to high energy radiation. (JPS-14)

**16.1.20.** Polystyrene has been crosslinked by atomic pile radiation, the degree of crosslinking being proportional to the radiation dose. Charlesby studied the swelling properties of crosslinked polystyrene as a function of crosslinking. The energy required to produce a crosslink in polystyrene by high energy radiation is much greater than in many other linear polymers. (JPS-15)

**16.1.21.** Bawn & Wajid studied the thermodynamic properties of polystyrene solutions. Measurements were made of the osmotic pressure of polystyrene fractions in toluene and methyl ethyl ketone at 25, 50, and 55°. The heat of dilution of polystyrene in these solvents was determined. Vapor pressure measurement of polystyrene fractions in acetone, chloroform, and propyl acetate solutions are summarized and the heat of dilution in these solvents derived. The results are discussed in relation to existing theories of the free energy and entropy of dilution of polymers, and it is shown that the results cannot be explained in terms of theories based on the lattice model of solutions. (JPS-25)

**16.1.22.** Trementozzi & Buchdahl determined the molecular weight, size and second virial coefficient for a series of styrene polymers prepared under high pressure (0-4000 atmospheres) using light scattering techniques. The intrinsic viscosity—molecular weight relationship, the size-molecular weight relationship and the magnitude of the second virial coefficient reveal no significant differences when compared to similar data of regular polystyrene. Structural differences due to the method of polymerization do not exist to the extent that they can be revealed by such measurements. (JPS-28)

**16.1.23.** A fast drying, mineral spirit resistant copolymer produced by co-polymerizing a vinyl aromatic compound and a non-conjugated unsaturated oil which has been partially polymerized by blowing with a free oxygen-containing gas and which is selected from the group consisting of drying oils and semi-drying oils at a temperature of from about 225° F. to about 500° F. in the presence of from

0.02% to about 1% by weight of the oil of a heavy metal drier soluble in the oil and from 0.5% to about 2.0% by weight of the oil of a metal-free peroxide, in which copolymer the ratio of vinyl aromatic compound to oil is in the range of from 60:40 to 25:75. (USP-27)

**16.1.24.** A solid interpolymerization product of at least two different substituted alpha methyl styrene liquids consisting essentially of (1) at least one alpha-methystyrene which has at least one nuclear substituent selected from the group consisting of halogen, trifluoromethyl, methyl and hydrogen on the 3,4 or 5 positions and (2) at least one member of the group consisting of the 3,4 and 3,5 dihalo-alpha-methylstyrenes, all of the alpha-methylstyrenes being characterized by absence of substituents on the 2 and 6 positions on the nucleus. (USP-85)

**16.1.25.** The Marbon Corporation has issued 8-page revision of Technical Report CY-1, describing properties and uses of Cycolac: a new high-impact thermoplastic resin based on styrene.

cf: 2.1.1
2.1.22
4.3.2
6.2.1
17.1.3
17.1.9
18.1.2
18.1.11
18.1.12
18.1.14
20.2.1
37.2.2
44.2.9
44.2.10
50.1.4
50.4.6
50.5.3
50.10.2

Manufacturers:
Bakelite Company
Dow Chemical Company
Emerson & Cuming, Inc.
Koppers Company, Inc.
Monsanto Chemical Company
Pennsylvania Industrial Chemical Corp.

**Methyl And Dimethyl Styrenes**

**16.2.1.** A new process for methyl and dimethylstyrenes is being piloted by American Cyanamid Co.'s Stamford, Conn., laboratories. It by-passes benzene, utilizes acetylene, acetaldehyde, toluene and xylenes as starting materials. Products can replace styrene in several polymer applications, have added potential in the synthesis of new plastics. (*CW-5*)

**16.2.2.** A new method of preparing ring substituted methylstyrenes is the vapor-phase cracking of unsymetrical diarylethanes using clay catalysts at exceedingly short contact times. Dixon & Saunders describe the production of methylstyrenes and dimethylstyrenes from diarylethanes by this method. The properties of methylstyrenes and dimethylstyrenes are comparable to styrene except for their having a higher heat distortion temperature than styrene. (*IEC-49*)

cf: 16.1.18

## CHAPTER 17

# UNSATURATED POLYESTERS

### General

**17.1.1.** The use of polyester resins in the production of car bodies is discussed in terms of their use in the Corvette car body by Chevrolet. (CW-2)

**17.1.2.** Smith discusses the applications and uses of polyesters. Although unsaturated polyester resins vary in type and composition, they are generally solutions of unsaturated polyesters made from difunctional glycols and acids in a vinyl monomer. When catalyzed with a free radical catalyst, such as benzoyl peroxide, they cure by copolymerization of the vinyl monomer with the unsaturated groups in the polyester to yield a cross-linked or three-dimensional structure. The ability to cure or polymerize without evaluation of volatile byproducts is their outstanding characteristic. (IEC-67)

**17.1.3.** Parker and Moffett studied the physical properties of polyester resins. The ratio of unsaturated to saturated dibasic acid was varied in 10 mole % steps in four series of unsaturated polyesters. One of these was mixed with 20, 30, 40, and 50% styrene, while the others were mixed with 30% styrene. Flexural strength, modulus in flexure, tensile strength, modulus in tension, elongation, water absorption, and heat distortion points were determined on castings prepared from each mixture. The results are discussed. (IEC-68)

**17.1.4.** Cass and Burnett studied the inhibition of certain catalyzed polyester systems by observing viscosity changes of samples stored at room temperatures. Catalysts used were benzoyl peroxide, tert-butyl perbenzoate, di-tert-butyl diperphthalate and tert-butyl hydroperoxide. Inhibitors were quinone, hydroquinone, and tert-butyl catechol. In all cases studied quinone was the most effective inhibitor. Gelation-time measurements at elevated temperatures have been used to estimate the room temperature storage life of catalyzed inhibited polyester systems. (IEC-69)

**17.1.5.** Stafford & Shay itemize typical components of unsaturated polyester formulations and fractionation methods are discussed. Attention is concentrated on the polyester; some attention given to filler and cross-linking fractions. The dicarboxylic acids are identified by the characteristic infrared spectra of their N-benzylamides. The acids are isolated as the dipotassium salts and mixtures are resolved quantitatively by the application of ultraviolet spectrophotometry. A procedure for the isolation of the dihydric alcohols is described. The applicability of the procedures is demonstrated by the analysis of a commercial formulation. (IEC-70)

**17.1.6.** Robitschek & Bean present results which indicate that the diene reaction adduct of hexachlorocyclopentadiene with maleic acid can form the major portion of polyesters with unusual flame resistance, especially in the presence of a small amount of antimony oxide. In addition, other adducts suitable as intermediates for flame resistant polyester resins are described. (IEC-71)

**17.1.7.** Bjorksten, et al, consider polyester resin-glass fiber laminates from the standpoint of bond between the two components. One silane bonding agent is treated in detail. (IEC-72)

**17.1.8.** Witt & Cizek determined the effects of particle size of a filler on the flexural strength of two different molding resins. Silica sand was chosen as the filler. The resins were a melamine formaldehyde-type and an unsaturated polyester. Data obtained from the melamine resins were in contrast with those from the polyester mixes. (IEC-73)

**17.1.9.** Bockstahler, et al, prepared a family of unsaturated polyesters with regularly varied cross-linking potential (fumarate to succinate ratio). They were copolymerized with various amounts of styrene and the copolymers tested over a range of temperatures for deflection under load and torsional modulus. The cross-linking potential of the polyester was shown to have a larger influence on the properties tested than the ratio of polyester to styrene in the copolymer. (IEC-74)

**17.1.10.** Feuer, et al, state that comparative reactivity and cured resin property data of selected polyester resins derived from maleic anhydride indicate that the reactive polyester unsaturation is actually the fumaric type. Evidence for the isomerization of maleic double bonds to the fumaric form during polyesterification is presented; only the fumaric double bond is found in two different polyesters prepared from maleic anhydride as determined by polarographic analysis. (IEC-75)

**17.1.11.** Sheppard discusses polyester-glass molding compounds. Considerable skill is required to produce a compound with good flow characteristics and molding properties. (MP-22)

**17.1.12.** Unsaturated polyester resins have a polymerization mech-

anism which utilizes maleate and/or fumarate double bonds as the sites through which the linear polyester chains are cross-linked by vinyl-type monomers. The advent of these resins has presented the problem of detecting and determining their maleate and/or fumarate unsaturation. Application of the polarograph to simple solutions of the polymer is practical if the acid number of the material, a measure of its molecular weight, is taken into consideration. A method has been developed, by Hobart, for the polarographic determination of the maleate and/or fumarate unsaturation in polyester formulations, expressed as per cent maleic anhydride. (AC-16)

**17.1.13.** A new polyester is described. Most of its service and fabrication properties are at least equal to those of conventional polyesters. At present its higher cost will limit it to uses where fire-resistance is required. (MM-4)

**17.1.14.** Yaeger discusses polyesters as coating materials. The author covers types, application methods for coating polyester resins, surface preparation, uses of polyester coatings and 18 references. (APJ-61)

**17.1.15.** A thixotropic coating composition comprising a polymerizable liquid comprising a liquid unsaturated alkyd resin obtained by the esterification of a mixture of ingredients comprising a polyhydric alcohol and an ethylenically unsaturated polycarboxylic acid and a polymerizable glycol ester of methacrylic acid and a filler selected from the class consisting of $Fe_2O_3$, $Cr_2O_3$, ZnO, $TiO_2$, $Ni_2O_3$ and $SiO_2$, the aforesaid filler comprising, by weight, from 45 to 70 percent of the total weight of the thixotropic composition. (USP-7)

**17.1.16.** A composition suitable for coating and impregnating applications comprising an aqueous solution of a heat-convertible reaction product of a polyhydric alcohol and an $\alpha,\beta$-unsaturated dicarboxylic acid, said polyhydric alcohol being selected from the class consisting of polyhydric alcohols of from 2 to 6 hydroxyl groups per molecule and mixtures thereof, said polyhydric alcohol containing no functional groups other than OH groups, containing no oxygen except in the form of OH groups and having an OH C ratio of from 0.6 to 1.0, said $\alpha,\beta$-unsaturated dicarboxylic acid being selected from the class consisting of maleic acid and maleic anhydride, said reaction product being one having at least half of the COOH groups originally presented by the reactants esterfied as evidenced by the acid value of the reaction product but at the same time having an acid value of at least the minimum value for the particular OH/COOH ratio employed as defined by line AB of the figure, said reaction product being soluble in water without the aid of any alkaline solubilizing agent said composition combining the properties of dilutability with water to at least 15% concentration of the reaction product in water and the ability to provide insoluble, infusible films by heat-conversion. (USP-10)

**17.1.17.** A surface coating composition capable of producing, on curing, a crater-free film comprising a compatible blend of (1) a polyester resin composition comprising a polymerizable mixture of (a) a polymerizably reactive unsaturated alkyd resin, (b) a compatible polymerizably reactive material having at least one $CH_2 = C<$ group and (*c*) a catalyst for accelerating the copolymerization of (*a*) and (*b*) and (2) 0.01%-5% by weight of a phenolformaldehyde resin, based on the total weight of said polyester resin, wherein the phenol is selected from the group consisting of p-tertiary butyl phenol, p-secondary butyl phenol and o-tertiary amyl phenol and wherein said alkyd resin contains a plurality of polymerizably reactive alpha, beta enal groups. (USP-33)

**17.1.18.** A method for increasing the molecular weight of a performed polyester containing, as the only reactive groups therein, at least two hydroxyl radicals which comprises mixing and reacting a major proportion by weight of said preformed polyester with a minor proportion by weight of a polylactam in which at least 2 lactam radicals are linked through their nitrogen atoms by an acyl radical of a polycarboxylic acid, each of the carbonyl groups of the acyl radical being thus attached to a lactam radical and said polylactam being free from reactive substituents. (USP-146)

**17.1.19.** The Bakelite Company has issued 19-page booklet on Bakelite Polyester Resins for Reinforced Plastics.

**17.1.20.** The American Cyanamid Company has issued 5-page bulletin on Laminac Resin 4111. This resin is designed specifically for resistance to hot aqueous solutions.

**17.1.21.** The Atlas Powder Company has issued bulletins on Atlac 363—polyester binder resin for glass fibers, and on Atlac FP—flame resistant alkyd polyester resin.

**17.1.22.** The Celanese Corp. of America has issued several bulletins re: Marco Polyester Resins; a 21-page booklet giving description and formulations; a 6-page bulletin (M2) on The Marco Method for Producing Molded Laminates Between Low-Cost mating Molds; Bulletins M3 and M4 on spray coating with MR-Resin and spraying Marco ML-4 separating film.

**17.1.23.** The General Electric Company has issued a technical report describing properties and uses of their polyester resins.

**17.1.24.** The General Electric Company has issued product data sheets describing the properties and uses of G-E Polyester Resins AR 401, 403, 480, 493, 499, and 501.

**17.1.25.** The National Aniline Division has issued 52-page booklet discussing the composition and utilization of polyesters. Included are chemistry of unsaturated polyesters, uses for unsaturated polyesters, preparation of polyesters and polyester varnishes, and selected literature references.

cf: 2.1.1
2.1.12
2.1.22
37.2.2
50.3.6

Manufacturers:
American Cyanamid Company
Bakelite Company
Cargill, Inc.
Celanese Corporation of America
General Electric Company
Interchemical Corporation
Rohm & Haas Company
Shell Chemical Corporation

### Allyl

**17.2.1.** Lynn reviews the allyl resins. The term refers to polymers and copolymers formed by

either allyl alcohol or its many derivatives. The paper covers the chemistry of allyls, simple ester formation, zero-order reaction, chain transfer agents, raw materials, prices and production, technology and uses, cast allyl, pro's and con's, other applications, allyl resin properties, and 54 references. (MF-3)

**17.2.2.** A number of allyl esters of carbamic acid have been synthesized by Gleim. Their properties, as well as those of some of their polymers, are reported. (JACS-23)

**17.2.3.** Lewis & Mayo studied the benzoyl peroxide-initiated reactions of propylene, isobutylene, allyl acetate and allyl chloride with carbon tetrachloride, and of propylene and isobutylene with chloroform, at 100°. Various monomer-solvent ratios and concentrations of initiator were employed. Optimum solvent-monomer feed ratios varied from 1 to 10. Nearly all reaction mixtures gave products averaging more than one monomer unit per molecule. Yields are discussed in terms of termination mechanisms, transfer constants and polar and steric effects. (JACS-29)

**17.2.4.** Butler & Johnson prepared and characterized a number of quartenary ammonium compounds having the propargyl group as one or more of the substituents to compare their polymerization characteristics to the corresponding allyl derivatives. Polymerization studies showed that only those compounds containing two or more allyl groups produced polymers, and that the propargyl groups did not enter into the polymerization. (JACS-31)

**17.2.5.** It has been shown that the diallyl esters of the arylphosphonic acids undergo polymerization to produce hard, transparent solids which are flame resistant. Further studies by Toy & Cooper, covering more than thirty allyl esters of phosphonic esters and other phosphorous-containing allyl derivatives have shown that glassy polymers are not obtained in all cases. Factors which appear to govern polymerization characteristics of these compounds are: (1) steric hindrance as determined by the size of the substituent group; (2) electrical character of the substituent group and (3) presence or absence of inhibitory groups. The dimethallyl esters polymerize faster than the corresponding diallyl esters. (JACS-48)

## CHAPTER 18

# VINYLS

### General

**18.1.1.** Lynn & Kobe describe a process for producing vinyl chloride by reaction of chlorine directly with product gases from the Schoch, Sachse, and Wulff processes which contain about 10% acetylene. Acetylene thus produced from hydrocarbons is cheaper than carbide acetylene, the vinyl chloride can be removed from the product gas more readily than acetylene, and the dilute gas prevents localized heating which destroys catalyst activity. A pure vinyl chloride that passes polymerization tests is readily made by this process. (IEC-48)

**18.1.2.** Schildknecht reviews the vinyl type polymers. The polymers obtained from ethylene, styrene, acrylic, vinyl, and vinylidene monomers make up a family unique in commercial expansion and variety of applications. (CEN-2)

**18.1.3.** For its 50th anniversary, Naugatuck is adding 50 million pounds capacity for nitrile rubber, plastics, and agricultural chemicals. Its vinyl output in being doubled. (CEN-14)

**18.1.4.** Schwahn discusses vinyl resins for industrial coatings. Fourteen years ago vinyl resins had a small but important place in the specialty field. The versatile properties of vinyl resins, have fostered a tremendous increase in production since that time. Correspondingly, vinyl resin prices have decreased.

Chemically the vinyl polymers would include all polymers containing the vinyl group. However it is common industrial practice to classify the polymers and copolymers of vinyl chloride and vinyl esters apart from those of styrene, ethylene and esters of acrylic acid, which chemically would be classed as vinyls.

Approximately 80% of the vinyl resin production is of the vinyl chloride type polymers. The bulk of this group are the vinyl chloride-vinyl acetate copolymers which today make up the bulk of the vinyl resins used in surface coatings. (OD-30)

**18.1.5.** Price & Morita discuss the copolymerization characteristics and spectra of phenyl vinyl sulfide and sulfone. The copolymerization characteristics of phenyl vinyl sulfide and sulfone are very nearly identical to those for methyl vinyl sulfide and sulfone. An explanation has been suggested for the lack of added conjugation when a phenyl sulfide group is attached to a vinyl or phenyl group, whereas there is a marked increase in conjugation when a vinyl sulfide group is attached to a vinyl group. (JACS-2)

**18.1.6.** Buege determined the effectiveness of a series of peroxide-type catalysts in vinyltoluene-drying oil reactions in producing clear reaction products, suitable for paint vehicles. Other factors contributing to the formation of these products are oil reactivity, ratio of oil to vinyltoluene, reaction temperature, and method of monomer addition. (IEC-77)

**18.1.7.** The use of rigid vinyl resins requires a knowledge of their thermal expansion characteristics and dimensional stability. A simple apparatus to measure differential coefficient of expansion is described by Dannis. Shrinkage during the annealing or heat-treating process is also easily measured. Expansion coefficients of a given sample depend upon method of preparation as well as upon compounding. Values are in the range of 70-200 x $10^{-6}$/°C. (MP-18)

**18.1.8.** Gilber, et al, report on vinylidene cyanide. Its homopolymerization proceeds vigorously by an ionic mechanism. Polymerization by free radical initiation is slow. The resulting polymer undergoes carbon chain scission in the presence of moisture. (JACS-37)

**18.1.9.** Westfahl & Gresham report that vinylidene cyanide reacts, in the presence of two equivalents of anhydrous aluminum chloride, with certain aromatic compounds to give monosubstituted malononitriles of the type $ArCH_2CH(CN)_2$. The reaction succeeds with aromatic hydrocarbons, phenols, phenol ethers and certain aromatic heterocycles. It fails with aromatic compounds which polymerize vinylidene cyanide or which are sufficiently deactivated by electron attracting groups. The introduction of two $-CH_2-CH(CN)_2$ groups can occur with suitably active aromatic compounds. (JACS-38)

**18.1.10.** Overberger & Kogon describe convenient synthesis of 4-vinylpyrimidine and 2-N,N-dimethylamino-4-vinylpyrimidine Polymers have been prepared by radical catalysis and characterized. The vinylpyrimidines are inactive against Sarcoma 180. (JACS-45)

**18.1.11.** Tobolsky & Baysal review the rates of initiation in vinyl polymerization: styrene and methyl methacrylate. Following an introduction they discuss—absolute method for Determination of A' (a characteristic property for each monomer), catalyzed polymerization of styrene and methyl methacrylate, computation of rates of initiation of polymer chains, combination versus disproportionation,

and catalyst efficiencies. (JPS-12)

**18.1.12.** The polymerization of certain vinyl monomers in the presence of some vinyl polymers leads to the formation of a chemical bond between the resulting two polymers. Hayes has made a study of the efficiency of this graft copolymerization process under various conditions and the following conclusions have been drawn. Increasing the catalyst concentration and temperature of polymerization increases the efficiency, while the addition of dodecyl mercaptan decreases it. The monomers used, in order of decreasing activity toward graft copolymerization are vinyl chloride, vinyl acetate, styrene. The polymers used in order of decreasing susceptibility to graft copolymerization are polyvinyl chloride, polyacrylonitrile, polyvinyl acetate and polystyrene. (JPS-16)

**18.1.13.** Frisch, et al, discuss the configuration and optical activity of vinyl polymers. Starred carbon atoms in vinyl polymers of the type $-(CH_2C^*XY)_n-$ exist in two steric configurations (devoted here as + and −). The existence of these configurations leads to the formation of different types of polymers. No simple relation correlates the optical activity with the distribution of + and − along the polymeric chain. The various possible structures are discussed in some detail. The kinetics of such polymerizations initiated by an optically active catalyst are treated by statistical methods. (JPS-19)

**18.1.14.** Price, et al, have copolymerized β-vinylnaphthalene, 6-chloro-2-vinylnaphthalene, 4-chloro-1-vinylphenanthrene, and 2- and 3-vinylphenanthrenes with styrene, methyl methacrylate and methyl acrylate. All copolymerize well to give products generally softening at higher temperatures than polystyrene or its copolymers. (JPS-21)

**18.1.15.** Tasset & Smets studied the degradation of vinyl polymers in dilute solution (1%) in the presence of an equivalent amount of benzoyl peroxide in a temperature range from 65 to 100°C. (JPS-42)

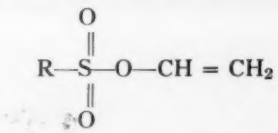
**18.1.16.** Campbell, et al, describe a method for determining the distribution of molecular weights of polyvinylpyrrolidone (P.V.P.) by measurement of the turbidity produced in aqueous solution by varying concentrations of sodium sulfate. The reproducibility and stability to autoclaving of this polymer are shown to be satisfactory. (JPS-46)

**18.1.17.** Process which comprises supplying (A) a polymerization-produced latex of a copolymer of (1) a butadiene-type compound selected from the group consisting of butadiene, isoprene, 2-methyl pentadiene-1,3, and mixtures of these compounds with (2) from about 15% to about 75%, based on the weight of the copolymer, of an acrylonitrile-type compound selected from the group consisting of acrylonitrile, methyl acrylonitrile, and mixtures of these compounds, substantially dewatering said latex without the application of heat, dissolving the copolymer in an organic solvent therefor to form a true solution thereof, incorporating in said solvent, for 20 to 120 parts of the copolymer, (B) 100 parts of a resin selected from the group consisting of polymers of vinyl chloride and copolymers thereof with up to 20%, based on the weight of such copolymers, of non-cross-linking unsaturated compounds copolymerizable therewith, casting, upon a support, a film from the resulting solution, drying said film, and stripping said film from said support. (USP-13)

**18.1.18.** A process for producing a somewhat rubbery formstable, non-sticky, curd-like polyvinyl methyl ether which comprises polymerizing vinyl methyl ether at a temperature from about —50° C. to about—70° C. in the presence of about 1%, based on the weight of the vinyl methyl ether, of a catalyst therefor and up to 9 parts by volume of diluent per part of said catalyst. (USP-35)

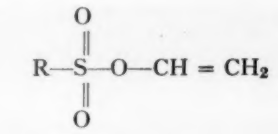
**18.1.19.** A composition of matter comprising a stable homogeneous mixture of from about 20% to 70% by weight of disodium hydrogen phosphate dodecahydrate in a bodied glyceride oil having a viscosity of from about 40 to 1100 seconds (Gardner-Holdt), the water present in said homogeneous mixture being chemically associated with the disodium hydrogen phosphate salt in the ratio of 12 mols of water to 1 mol of the disodium hydrogen phosphate salt and said homogeneous mixture being dispersed in a halogen-containing resinous polymeric material in the proportion of from .1 to 10 parts per 100 parts of resin. (USP-38)

**18.1.20.** A monomeric vinyl ester of a hydrocarbon-sulfonic acid having the formula



wherein R is a monovalent saturated hydrocarbon radical.

A method for preparing a copolymer of a vinyl ester of a hydrocarbonsulfonic acid which comprises contacting at a temperature of 0° to 150° C. with an addition polymerization initiator, a monomeric ethylenically unsaturated polymerizable compound and a monomeric vinyl ester of a hydrocarbonsulfonic acid having the formula



wherein R is a monovalent hydrocarbon radical selected from the class consisting of aryl and saturated hydrocarbon radicals. (USP-81)

**18.1.21.** Sparta Industries has announced Sparsol 77, a new vinyl type resin containing no chlorine, and which can be used as a very high solids content in solution.

**18.1.22.** The Goodyear Tire and Rubber Company introduced Pliovic DB8OV, a dry blending grade of vinyl resin.

cf: 13.1.4
13.1.9
15.1.15
15.1.26
20.1.3
20.1.4
20.3.1
49.1.7
50.10.2

Manufacturers:
Bakelite Company
Sparta Industries

### Polyvinyl Acetate

**18.2.1.** Kokes and Long have studied the diffusion at 40° of vapors of propyl chloride, allyl chloride, propylamine, isopropylamine and carbon tetrachloride into

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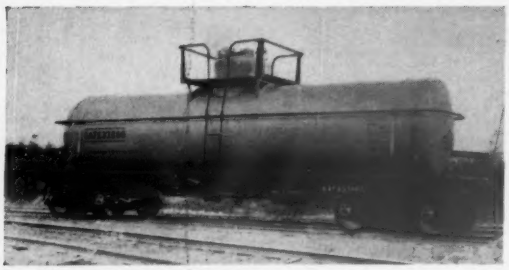

**for the RAILROAD INDUSTRY:** Don't forget: the railroad industry requires coatings of many types . . . for steelwork and bridges, for station interiors and exteriors, for rolling stock. For freight cars, coatings based on BAKELITE Vinyl Resins have proved considerably longer service life, with very low maintenance despite corrosive loads, rough handling, vibration, and severe weather.

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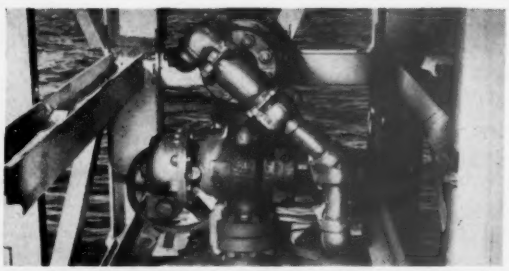
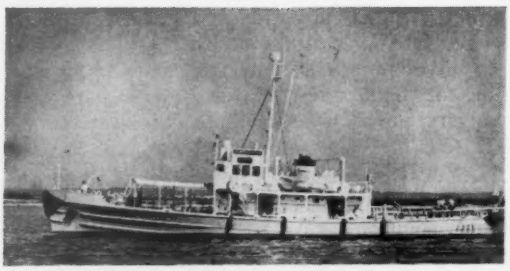
**for the BUILDING INDUSTRY:** You can formulate for all types of surfaces, increasing your sales package. For concrete flooring, an air-dry enamel finish, based on BAKELITE Phenolic Resins showed less than 10% wear after five years of heavy truck traffic and operations of this bottling plant and warehouse.

**for the AUTOMOTIVE INDUSTRY:** Primers, as well as finish coats, are a source of big volume. With BAKELITE Vinyl Butyral Resins you can formulate wash primers that bond firmly to aluminum and steel without flaking. They provide a firm grip for topcoats, and prevent creepage of corrosion even when topcoats are scratched.



**for the PETROLEUM INDUSTRY:** Offshore wellheads of two major oil companies used to require a full-time continuous painting program. Now, with a coating system based on BAKELITE Vinyl Resins this costly maintenance has been replaced with routine check-ups. The new finishes are permanently neutral, chemical resistant, non-oxidizing and non-heat-reactive.



**for the MARINE INDUSTRY:** Weather, rough service, salt-water and corrosive cargoes all demand tough coatings. You can sell this market with tested finishes based on BAKELITE phenolic resins for superstructures, interior metalwork and equipment, deck varnishes, and anti-fouling coatings for below the waterline. Tests show continued perfect protection after more than three years' service.

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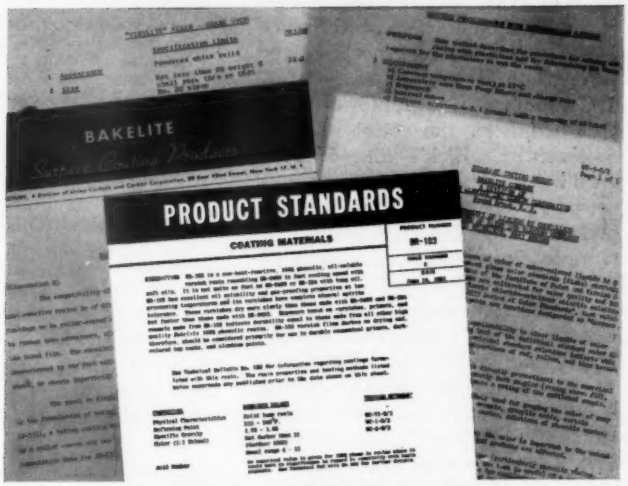


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films of polyvinyl acetate as a function of concentration. Two other vapors, 1-propanol and benzene, have been studied at three temperatures, 30, 40, and 50°. The diffusion is Fickian. (JACS-21)

**18.2.2.** Meares studied the diffusion of helium, neon, argon, oxygen and hydrogen through high molecular weight polyvinyl acetate in the temperature range 4-44°. Diffusion coefficients were determined using the time-lag method and permeabilities from steady state measurements. Solubilities were obtained from the ratios of these coefficients. Fick's and Henry's laws were accurately obeyed for all the gases over the temperature and pressure range investigated. Logarithmic plots of diffusion, permeability and solubility coefficients against reciprocal temperature show two transition temperatures. The upper one, 26°, is the same for all the gases and corresponds with the usually quoted second-order transition of polyvinyl acetate. The lower one decreases from 18-15° as the molecular size of the diffusing gas increases. The heat of solution of the gases usually reverse from (−) to (+) on entering the transition region from below. (JACS-61)

**18.2.3.** Shultz made a light scattering and viscosity study on polyvinylacetate. It confirmed the prediction that the extent to which a linear polymer molecule is expanded beyond its random-flight dimensions is a function of its molecular weight. The ratio of the mean-square radius of a linear polymer chain to its molecular weight increases with increasing molecular weight for a polymer in a thermodynamically good solvent. The Flory-Fox limiting viscosity number theory is found to be valid for high molecular weight polyvinylacetate fractions in methyl ethyl ketone. The value $\varnothing = 2.2. \times 10^{21}$ is observed for the universal viscosity constant. (JACS-62)

**18.2.4.** A liquid copolymer of vinyl acetate with a mono-olefin having from two to four carbon atoms, said copolymer containing from 60 to 80% by weight combined vinyl acetate and having an average molecular weight from 350 to 1200. (USP-51)

**18.2.5.** E. I. duPont de Nemours & Co., Inc. has issued Vinyl Products Bulletin V16-654 on "Elvadex" Vinyl Polymers; an unique vinyl acetate copolymer soluble in aqueous alkali.

**18.2.6.** The Monsanto Chemical Company has issued Product Development Bulletin describing properties and uses of Polymer C-3, a modified vinyl acetate resin.

cf: 18.1.12
Manufacturers:
American Monomer Corporation
American Polymer Corporation
Bakelite Company
The Colton Chemical Company
E. I. duPont de Nemours & Co., Inc.
Monsanto Chemical Company
National Starch Products Inc.
Paisley Products, Inc.
Shawinigan Products Corporation

### Polyvinyl Chloride

**18.3.1.** Byrne and others have found halogenated plastics such as polyvinyl chloride and polymonochlorotrifluoroethylene release halogen when exposed to gamma radiation. Thus a normally inert material becomes a source of corrosion and contamination. Tests were made on unplasticized plastics. Large changes in tensile, impact and shear strength were found—improvements in some instances and substantial deterioration in others. The results are not sufficiently complete to permit forming a hypothesis of the mechanism of the halogen evolution. It is possible, however, to estimate the order of magnitude of the evolution. (IEC-20)

**18.3.2.** General Tire & Rubber's chemical division is producing a new polyvinyl chloride resin in a new Ashtabula (Ohio) plant using a suspension polymerization process.

In general, PVC resins have the same physical properties—tensile strength, percent elongation, hardness, etc.—regardless of method of manufacture. Properties which do vary are heat stability, electrical properties, chemical resistance, and water resistance.

Of the four major types of vinyl chloride polymerization techniques —bulk, solution, emulsion, and suspension, probably no one method produces all the varieties desired. (CEN-24)

**18.3.3.** Huscher, in Materials & Methods Manual #105, covers the following, to assist in the selection and use of polyvinyl chloride: physical and chemical properties, machining and cutting, forming methods, joining methods and design suggestions. PVC is relatively new structural material now available. It offers a wide range of excellent properties such as light weight, good corrosion resistance, and ease of fabrication. (MM-3)

**18.3.4.** Arlman reports an investigation into the kinetics and the mechanism of thermal and oxidative decomposition of polyvinyl chloride. The results indicate that thermal decomposition starts at the end groups of the macromolecules, whereas oxygen initiates decomposition within the chain. (JPS-43)

**18.3.5.** A resinous composition comprising a vinyl chloride polymer plastized with an adduct of one mole of an ester selected from the class consisting of dialkyl and bis (alkoxyalkyl) esters of a dimeric, unsaturated vegetable oil fatty acid in which each alkyl and each alkoxyalkyl radical has from 1 to 8 carbon atoms and from 1 to 4 moles of a fumarate selected from the class consisting of dialkyl and bis (alkoxyalkyl) fumarates in which each alkyl radical and each alkoxyalkyl radical has from 1 to 8 carbon atoms. (USP-36)

**18.3.6.** A polyvinyl chloride resin composition containing a plasticizer, said composition having its viscosity lowered by an agent selected from the group consisting of long chain fatty acid esters of polyoxyalkylenes, long chain fatty ethers of polyoxyalkylenes, partial long chain fatty acid esters of polyoxyalkylene ethers of polyhydric alcohols, polyoxyalkylenes having an average molecular weight of at least 1500, and nuclear long chain alkylated polyoxyalkylene ethers of phenols. (USP-50)

**18.3.7.** A light-stable composition comprising a polymer of a monomeric mixture comprising from 75 to 90% by weight of vinylidene chloride, 5 to 15% vinyl chloride and 5 to 15% of ethyl acrylate and a minor amount of a water-soluble ammonium salt of a styrene maleic anhydride copolymer. (USP-104)

**18.3.8.** A process for producing polymer of vinyl chloride adapted for production of plastisols which retain mobile fluidity upon storage over extended periods of time which comprises the combination

of steps in seriatim of emulsifying liquid monomeric vinyl chloride having not more than about 5% by weight of another mono-olefinic polymerizable compound in admixture therewith and also containing a peroxide polymerization catalyst dissolved therein with an aqueous solution containing about 0.1 to 5% by weight of an emulsifying agent, homogenizing the emulsion by subjecting it to violent shearing action, heating the homogenized emulsion with agitation at a temperature of about 30° C. to 60° C. to thereby polymerize the vinyl chloride, venting unpolymerized vinyl chloride from the emulsion and thereby substantially freeing the polymer emulsion of unpolymerized vinyl chloride, and then subsequently heating the uncoagulated aqueous emulsion of polymer at a temperature of about 90° C. to 160° C. for a time from about 10 seconds to 10 minutes, but less than the time required to appreciably agglomerate and coagulate the polymer particles while maintaining the polymer in intimate contact with liquid water during the whole of this heating period. (USP-111)

**18.3.9.** The Dow Chemical Company has issued bulletin describing properties and uses of PVC 100—Dow Polyvinyl Chloride.

**18.3.10.** The Firestone Plastics Company has issued 38-page brochure describing various Exon polyvinyl chloride copolymer resins.

**18.3.11.** The Firestone Plastics Company has issued Sales Service Bulletins #8 and #11 describing Exon vinyl chloride copolymer resins 470 and 471.

**18.3.12.** The Goodyear Tire & Rubber Company, Inc. has issued 9-page Techni-Guide PVR-100-8 describing Pliovic EDB90V dry blending polyvinyl chloride resins.

**18.3.13.** The Monsanto Chemical Company has issued Opalon Data Sheet No. 061, describing Opalon 410, a vinyl chloride base resin for preparation of vinyl plastisols.

cf: 2.1.1
2.1.22
3.1.6
18.1.2
18.1.4
18.1.12
20.2.1
36.8.2
36.8.3
36.8.4
39.14.2
Manufacturers:
Bakelite Company
Dow Chemical Company
Firestone Plastics Company
B. F. Goodrich Chemical Company
The Goodyear Tire & Rubber Co., Inc.
Monsanto Chemical Company

### Chloride-Acetate Copolymers

**18.4.1.** The effects of varying catalyst concentration, temperature, and time of polymerization upon conversion, heat stability, molecular weight, and chlorine content of the copolymer of vinyl chloride and vinyl acetate were investigated by Emmer & Bankoff. In general, the results supported the theory that suspension polymerization is a special case of bulk polymerization in isolated droplets. (IEC-50)

cf: 2.1.1
4.1.7
18.1.4
20.2.4
Manufacturers:
Bakelite Company
Firestone Plastics Company

### Polyvinyl Alcohol

**18.5.1.** A process for the production of polyvinyl alcohol which comprises polymerizing vinyl acetate in the presence of a terminally unsaturated mono-olefin containing 12 to 18 carbon atoms the amount of said mono-olefin being equal to 0.01 to 10% of the weight of said vinyl acetate and the amount of any vinyl acetate solvent present during polymerization varying from zero to 30% by weight of the vinyl acetate and saponifying the resulting polyvinyl acetate until at least about 75% of the acetate groups have been converted to hydroxyl. (USP-92)

**18.5.2.** The American Monomer Corporation has issued 4-page bulletin M-13 R describing "Lemol" polyvinyl alcohol. Ten Lemol Grades are listed and properties described.

cf: 2.1.1
2.1.22
Manufacturers:
American Monomer Corporation
Bakelite Company
E. I. duPont de Nemours & Co., Inc.

### Polyvinyl Acetal

**18.6.1.** The resinous condensation product of a partially hydrolyzed polyvinyl alcohol ester homopolymer and a condensation product of ammonia and butyraldehyde. (USP-6)

**18.6.2.** A composition of matter comprising a polyvinyl acetal resin and 0.2 to 3 parts per 100 parts of said resin of a divalent heavy metal salt of fluorboric acid.

A composition of matter comprising a mixture of xylene and butanol having dissolved therein a polyvinyl butyral resin and 0.2 to 3 parts of tin fluorborate per 100 parts of said resin. (USP-142)

### Polyvinyl Butyral

**18.7.1.** Muller reviews a series of experiments on the mechanism of the action of wash primers with particular references to those based on polyvinyl butyral. The two-pack primer is superior to the single-pack type. The limited life of the wash primer is explained and other aspects of the reaction discussed, including the role of the polyvinyl butyral. The use of this material in other forms of surface coatings is also outlined. (PM-69)

**18.7.2.** Shawinigan Resins Corporation is giving one boost after another to its production of polyvinyl butyral. One of the reasons is increased use of safety glass. (CE-8)

**18.7.3.** Reacting polyvinyl acetate with butyraldehyde, Shawinigan Resins Corp., makes polyvinyl butyral resin. A Chemical Engineering Pictured Flowsheet shows how this is done. (CE-11)

**18.7.4.** The Bakelite Corporation has issued 26-page Technical Release No. 11 describing general properties and applications of Bakelite vinyl butyral resins.

cf: 2.1.1
39.2.1
39.2.4
Manufacturers:
Bakelite Company
Monsanto Chemical Company

### Polyvinyl Formal

**18.8.1.** Dieu studied the properties of polyvinyl alcohol solutions. Fractionation of an aqueous solution of crude polyvinyl alcohol was performed by acetone precipitation at 25°C. Ten fractions were obtained. Intrinsic viscosities were measured in three different solvents, water, water-dioxane (10%) and water-dioxane (33%) at several temperatures in range of 0-100°C. Flory's theory of in-

trinsic viscosity was applied to the three fractions and the values of the enthalpic and entropic parameters were deduced for the three solvents. A relation between intrinsic viscosity and the ultracentrifugation molecular weight is given. (JPS-34)

Manufacturer:
Monsanto Chemical Company

**Vinylidine Chloride Polymers**

**18.9.1.** A composition of matter consisting essentially of the copolymer of from 88 to 94 per cent vinylidene chloride and correspondingly 12 to 6 per cent vinyl chloride and from 0.5 to 5 per cent of the weight of the composition of tetrasodium pyrophosphate, from 1 to 5 per cent by weight of acetyl triethyl citrate, and from 2 to 6 per cent by weight of salol, the aggregate amounts of the citrate and salol not exceeding 9 per cent of the composition by weight. (USP-130)

cf: 2.1.1
2.1.12
2.1.22
18.1.2

Manufacturer:
Dow Chemical Company

## CHAPTER 19

# EMULSIONS

### General

**19.1.1.** Parker presents a discussion of resin polymer emulsions and their revolutionary effect on paint and a variety of other products. Discussion is primarily on use of polyvinyl acetate and includes advantages of emulsions, first use as a sealer, pigments, pH adjustment, plasticization, formulation, manufacture of polyvinyl acetate emulsions, and sampling. (CPVM-17)

**19.1.2.** An oil-in-water resin emulsion textile decorating pigment color composition comprising water, between about 4.5% and about 31% of an emulsified resin-binder, between about 0.18% and 2.16% of an emulsifying agent selected from the class consisting of soaps of fatty acids, fatty acid esters of polyethylene glycols, quaternary ammonium salts, fatty alcohol sulfates, polyethyleneoxide condensation products polymerized glycol esters and sodium salts of organic sulfonates, between about 0.075% and 4.34% of a protective colloid selected from the class consisting of casein, ammonium caseinate, methyl-cellulose, sodium carboxymethylcellulose, gum tragacanth, dextrine, starch, sodium acrylate, sodium methacrylate, water-soluble and alkali-soluble hydroxyethylcellulose, locust bean gum, water-soluble salts of the maleic adduct of styrene and alginates, between about 7% and 2.5% of a dispersed pigment which is a member of the class consisting of phthalocyanine pigments, insoluble azo pigments, vat pigments and carbon blacks, said emulsified resin-binder comprising a polyunsaturated fatty acid ester of a polyhydric alcohol in an emulsion polymerized state, the vehicle solids of the emulsion being sensitive to the action of the air, when exposed to it in a thin layer of a wet film thickness of 0.0015" to 0.003", forming a coherent solid film immediately upon demulsification of the emulsion, said solid film formation being reached within a period ranging from a couple of seconds to one hour, the solid polyhydric alcohol esters forming the dispersed phase of the emulsion having an oxygen content which does not exceed the oxygen content of the unemulsified polyhydric alcohol esters by more than 2.8%, said percents being by weight and being based on the total composition, said pigment color composition being viscous and being suitable as a color concentrate which is dilutable with clear extender print paste emulsions to form the desired strength of shade when used for textile printing, said fatty acid ester being a member of the class consisting of (i) styrenated alkyd resins comprising fatty acids in the acid component, (ii) styrenated fatty oils and (iii) pentaerythritol-glycerine mixed esters of maleic anhydride treated fatty acids, all of said fatty acids containing polyunsaturated fatty acids. (USP-136)

**19.1.3.** The Union Bay State Chemical Co., Inc. is supplying a modified vinyl polymer emulsion called U 2001 Ubatol, infinitely dilutable with water, and compatible with all emulsifiable materials commonly used in floor finish compounding.

**19.1.4.** The American Polymer Company has issued brochure "Polymers for Textiles" covering Polyco emulsion polymers.

cf: 38.1.11
40.1.5
40.1.6
Manufacturer:
Snyder Chemical Corp.

### Acrylic

**19.2.1.** With a major mail order house's introduction of a line of acrylic paints in February, acrylics are making a strong bid for a share of the billion-dollar paint market. Particular baby of Rohm and Haas, the acrylic emulsions are also being produced by American Polymer Corp. (CW-11)

**19.2.2.** Fram, et al, describe reinforced acrylate elastomers cast from emulsion. Various acrylate elastomers were emulsion polymerized and compounded by direct emulsion reinforcement. Films cast from these emulsions retained their translucent optical quality as a result of a judicious choice of fillers. The strength properties were significantly improved by copolymerization with increased amounts of acrylonitrile and by loading with finely divided, non-carbon-type fillers. By the proper combination of the base elastomeric copolymer and the loading volume of the reinforcing agent, elastomers with a wide range of physical properties were developed. (IEC-88)

**19.2.3.** The Rohm and Hass Company has issued 18-page bulletin on Rhoplex AC-33; acrylic resin emulsion for water base paints.

**19.2.4.** The Rohm and Haas Company has issued 24-page Progress Report #1 on Rhoplex AC-33 for Exterior Paints.

cf: 3.1.3
40.1.5
40.1.6
Manufacturers:
American Polymer Corp.
Rohm & Haas Company

Another Quality Chemical by General Tire

# HERE'S WHAT TO LOOK FOR IN Paint Latex

You just can't buy a better paint latex than Gen-Flo*. When tested against samples of the top four competing latices Gen-Flo emerged as the best *balanced* latex—either equal to or better than other products in all the vital requirements.

For sample and reference data on Gen-Flo write to The General Tire & Rubber Company, Chemical Division, Akron, Ohio.

**COMPARATIVE LATEX PROPERTIES**

| Property | Gen-Flo Latex | Latex A | Latex B | Latex C | Latex D | |
|---|---|---|---|---|---|---|
| Viscosity—cps. | 21 | 21 | 18 | 77 | 14 | |
| Residual Styrene % | 0.03 | 0.02 | 0.22 | 0.07 | 0.05 | |
| Odor | Very Mild | Very Mild | Ammonia | Sour Sweet | Mild | |
| Mechanical Stability % | 0.03 | 0.02 | 0.03 | Creamed-Thickened | Custard Consistency | |
| Film Specs | Good | Good | Poor | Fair | Excellent | |
| Stabilization System | Balanced | Balanced | Over Stabilized | Over Stabilized | Under Stabilized | |
| **NON-MODIFIED PAINTS** | | | | | | |
| Tests | | | | | | Control Paint |
| Freeze-Thaw Stability | | | | | | |
| Original—cps | 880 | 360 | 580 | 580 | 1120 | 2000 |
| After 1st cycle | 780 | 360 | 600 | 780 | coag. | 2200 |
| After 2nd cycle | 740 | 350 | 580 | 720 | — | 1850 |
| After 3rd cycle | 700 | 340 | 560 | 660 | — | 1380 |
| After 4th cycle | 850 | 370 | 620 | 900 | — | 2010 |
| After 5th cycle | 900 | 360 | 740 | 1260 | — | 2560 |
| Scrubs to Failure | | | 16 hours at –20° F. 8 hours at 77° F. | | | |
| 24 hour dry | 2000+ | 2000+ | 393 | 2000+ | 2000+ | 2000+ |
| 48 hour dry | 2000+ | 2000+ | 2000+ | 2000+ | 2000+ | 2000+ |
| Cleansability (strokes to remove) | | | Fed. Spec. TT-P-0029 with standard brush | | | |
| Crayon | 41 | 47 | 100+ | 93 | 34 | 100+ |
| Ink | 20 | 20 | 8 | 4 | 16 | 4 |
| Lipstick | 100+ | 100+ | 31 | 34 | 100+ | 33 |
| Mercurochrome | 100+ | 100+ | 15 | 100+ | 100+ | 4 |
| Pencil | 100+ | 100+ | 100+ | 100+ | 100+ | 46 |
| | | | Fed. Spec. TT-P-0029 with standard brush, except Bon Ami instead of soap solution | | | |
| **OIL MODIFIED PAINTS** | | | | | | |
| Freeze-Thaw Stability | | | | | | |
| Original—cps | 2050 | 1490 | 1180 | 930 | 2490 | 3200 |
| After 1st cycle | 2230 | 1500 | 1700 | 1610 | coag. | 1980 |
| After 2nd cycle | 2170 | 1590 | 2280 | 3090 | — | 2070 |
| After 3rd cycle | 2100 | 1880 | 2650 | 4870 | — | 2360 |
| After 4th cycle | 2260 | 1810 | 3580 | 6680 | — | 2180 |
| After 5th cycle | 2450 | 1790 | 5310 | coag. | — | 2060 |
| Scrubs to Failure | | | | | | |
| 48 hour dry | 219 | 138 | 87 | 90 | 267 | 65 |
| 96 hour dry | 1000+ | 1000+ | 240 | 186 | 1000+ | 80 |
| Cleansability (strokes to remove) | | | Fed. Spec. TT-P-0029 with standard brush | | | |
| Crayon | 35 | 24 | 37 | 18 | 19 | 25 |
| Ink | 10 | 7 | 31 | 5 | 18 | 17 |
| Lipstick | 54 | 46 | 73 | 36 | 33 | 15 |
| Mercurochrome | 100+ | 100+ | 80 | 47 | 100+ | 69 |
| Pencil | 59 | 83 | 85 | 25 | 27 | 58 |
| | | | Fed. Spec. TT-P-0029 with standard brush, except Bon Ami instead of soap solution | | | |

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### Polystyrene

**19.3.1.** The principle of incorporating aqueous resin or oil emulsions into "water based" paints as a means of improving the water resistance and physical properties of films produced from them is briefly reviewed by Taylor, leading to the development of the so-called synthetic resin emulsion paints based on polyvinyl acetate, polystyrene and styrene-butadiene copolymer emulsions.

"Film-forming polymer" emulsions (polyvinyl acetate and butadiene-styrene copolymers) are compared with emulsions of "non-film-forming polymers" (polystyrene, etc.), which must be plasticized by "external" means.

The manufacture and properties of polystyrene latices are discussed in general terms and the importance of correct selection of the plasticizer to ensure the production of continuous films on drying is stressed; the methods of "pre-plasticization" and "post-plasticization" of polystyrene latices are explained and compared.

Processes for preparing emulsion paints from post-plasticized polystyrene latices are mentioned and detailed attention is given to a discussion of the various ingredients used in this connection, their effects on the properties of the paints produced and the paint films finally obtained from them.

Plasticizers, fillers, pigments, protective colloids, preservatives, dispersing and wetting agents, defoaming agents and thickeners are dealt with in detail. (*JOCCA-27*)

cf: 19.4.2
40.1.6
44.2.21

Manufacturers:
American Polymer Corp.
Bakelite Company
Koppers Company, Inc.
Monsanto Chemical Company
Union Bay State Chemical Company Inc.

### Polyvinyl Acetate

**19.4.1.** Polyvinyl acetate seems cut out for coatings (interior, exterior, and primer-sealer) and it's getting close scrutiny from paint makers. Producing fast-drying, durable, easily applied films, PVA's price is still curbing current use. But cost is on the way down, and consumption on the way up. One conservative prediction: there'll be 30 million gallons of PVA paint sold yearly by 1957. (CW-10)

**19.4.2.** A paper "Vinyl Emulsion Polymers and their Use in Coatings", presented at a meeting of the London Section of O.C.C.A. discusses subject of emulsion paints based on vinyl emulsions. The paper covers the subjects of emulsion polymerization, formation of films and emulsions, preparation of emulsion paints, testing of resin emulsion paints. The observations discussed in the paper were based on several year's work in emulsion paints during which some 1,500 samples of paint were made & tested. (PM-25)

**19.4.3.** Davis discusses polyvinyl acetate emulsions as paint vehicles. Properly formulated PVA paints have 1. excellent light stability and aging, 2. low odor, 3. fast drying, 4. excellent adhesion to fresh plaster, concrete, wood, and other surfaces, 5. excellent resistance to fat and oil, 6. good alkali resistance, 7. good washability, 8. non-bleeding, and 9. ease of application and clean up. (PVP-41)

**19.4.4.** Port, et al, describe copolymers for water base paints from vinyl acetate and long-chain vinyl esters. Some of the advantages offered by polyvinyl acetate

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emulsion paints are high gloss, strong adhesion to many surfaces, and non-yellowing characteristics. Among the problems introduced by the use of polyvinyl acetate as a binder film, on the other hand, are water-sensitivity and the need for the addition of external plasticizers. Plasticization is necessary in order to lower the temperature at which a continuous polymer film will form. (OD-42)

**19.4.5.** Zahrndt reviews polyvinyl acetate paints. Although polyvinyl acetate emulsion paints have been known in Europe and England for some years, the marked interest in their use in the United States has occurred within the past two or three years. They have caught on particularly on the West Coast. (APJ-42)

**19.4.6.** Davis discusses polyvinyl acetate emulsion as a paint vehicle. Advantages are:

1. excellent light stability and aging
2. low odor
3. fast drying
4. excellent adhesion to fresh plaster, concrete, wood, and other surfaces.
5. excellent resistance to fat and oil
6. good alkali resistance
7. good washability
8. non-blistering
9. ease of application and clean up. (APJ-46)

**19.4.7.** Davis discusses the use of polyvinyl acetate as a paint vehicle. PVA paints offer:

1. excellent light stability and ageing
2. low odor and fast drying
3. excellent adhesion to fresh plaster, concrete, wood and other surfaces
4. excellent resistance to fat and oil
5. good alkali resistance
6. good washability
7. non-blistering
8. ease of application and clean up (PIM-19)

**19.4.8.** The process which comprises dispersing vinyl acetate monomer in an aqueous 2 to 10% by weight solution of a hydrophilic dispersing agent which is a polyhydroxy, polymeric, film-forming substance substantially insoluble in water at temperatures below 50° C. but soluble in water at a temperature not lower than 50° C. to form a dispersion containing not more than 5% by weight of said monomer, subjecting said dispersion to polymerization in the presence of a peroxygen type catalyst, while dispersing therein further quantities of said monomer so as to maintain a monomer concentration not greater than 5% by weight when the polymer concentration is not over 20% by weight and not greater than 3% by weight when the polymer content has exceeded 20% by weight, continuing as above until the polymer content has reached 20 to 60% by weight, controlling the pH of the polymerization reaction mixture so that it is initially not less than 4 and finally not greater than 6 and adding to the reaction mixture before polymerization is 50% complete a cyclic alcohol selected from the group consisting of the sterols, abietyl alcohol, dehydroabietyl alcohol the hydroabietyl alcohols and the sulfonated hydroabietyl alcohols in amount equal to not less than about 0.1% by weight of the water present. (USP-69)

**19.4.9.** The American Polymer Company has issued Bulletin P-49B on American Polymer Polyco Polyvinyl Acetate Emulsions for Water Base Paints and Primer Sealers.

**19.4.10.** E. I. duPont de Nemours & Co., Inc. has issued Vinyl Products Bulletin V11-254 on Preparation of Primer-Sealers With "Elvacet" 81-900 Polyvinyl Acetate Emulsions.

**19.4.11.** E. I. duPont de Nemours & Co., Inc. has issued Vinyl Products Bulletin V15-254 on "Elvacet" 81-900 Polyvinyl Acetate Emulsion as an Exterior and Interior Paint Vehicle.

**19.4.12.** National Starch Products, Inc. and Sierra Talc and Clay Company have issued a 14-page report on a Study on The Proper Use of Extender Pigments in Polyvinyl Acetate Paints.

**19.4.13.** National Starch Products, Inc. has issued 36-page Second Edition of booklet "National Resyns for Paints" describing vinyl acetate polymer and copolymer emulsions.

**19.4.14.** The Nopco Chemical Company has issued 6-page New Product Information Bulletin NP-30 describing properties and uses of Nopco 1572-R polyvinyl acetate emulsion.

**19.4.15.** Reichhold Chemicals, Inc. has issued Technical Bulletin SC-6 describing properties and uses of 9101-55 Wallpol, a water emulsion of polyvinyl acetate.

**19.4.16.** The Shawinigan Products Corporation has issued 4-page bulletin "Gelva Emulsion for Paints". Also six technical bulletins:

Gelva Paint Thinner 175
Gelva Emulsion Primer Sealer 178
Gelva Emulsion Paint 201
Gelva Emulsion Paint 237
Gelva Emulsion Paint 243
Gelva Emulsion Paint 246

**19.4.17.** The Sierra Talc and Clay Company has issued Report 27-T on "Pigmentation Studies of Polyvinyl Acetate Paints".

**19.4.18.** The R. T. Vanderbilt Company, Inc., has issued two Technical Data Sheets describing Norvan G, a new polyvinyl acetate emulsion and the Use of Norvan G in Exterior Masonry Paints.

cf: 19.3.1
20.1.4
40.1.2
40.1.6
40.1.7
40.1.8
40.1.9
40.1.10
44.2.20
44.2.21
46.1.8
49.1.7

Manufacturers:
American Polymer Corp.
Bakelite Company
The Colton Chemical Company
Dewey & Almy Chemical Company
E. I. duPont de Nemours & Company, Inc.
National Starch Products Inc.
Nopco Chemical Company, Inc.
Reichhold Chemicals, Inc.
Shawinigan Products Corp.
R. T. Vanderbilt Company, Inc.

### Chlorinated Natural Rubber

**19.5.1.** A coating composition consisting substantially of from about 25 to 45 per cent by weight of a chlorinated rubber, having a chlorine content within the range of from about 50 to 60 per cent by weight, from about 10 to 35 per cent by weight, based on the weight of the chlorinated rubber, of a plasticizer which is miscible with the rubber chloride and exerts a gelling action thereon a small amount of a compatible emulsifier and a vehicle of water the rubber chloride in said com

position being substantially free from oxygen, being substantially insoluble in organic solvents and resulting from the chlorination of an aqueous dispersion of an unmasticated rubber containing acid in a concentration of at least about 1 normal and an emulsifier stabilizing it against acid coagulation followed by recovery of the finely-divided chlorinated rubber from the resulting chlorinated dispersion. (USP-74)

**19.5.2.** Water-thinnable emulsion of chlorinated natural rubber is available as PE-16 Clear from Alfred Hague & Co., Inc. In achieving the stable emulsification of chlorinated natural rubber without oil modification heavy brush pull is overcome without sacrificing the properties of chlorinated natural rubber.

This emulsion can be used either as a modifier of other resin emulsions or as the sole film-forming portion of the vehicle in the preparation of water-thinnable paints.

**19.5.3.** Alfred Hague & Co., Inc. has issued 8-page Technical Bulletin #101 describing properties and uses of PE-16 Clear, a water-thinnable emulsion of chlorinated natural rubber.

Manufacturer:
Alfred Hague & Co., Inc.

### Butadiene-Styrene

**19.6.1.** Nisonoff, et al, describe a method based on Stokes' law, involving the use of an ordinary laboratory centrifuge, for the determination of particle size distribution in GR-S latices. It was shown to be valid by tests for reproducibility and by comparison with the results of light and electron microscopy. Data on various latices in plant production are reported. (AC-12)

**19.6.2.** The American Polymer Company has issued 5-page revision of Bulletin P-24 on Polyco Butadiene-Styrene Latices for Coatings, Adhesives, Saturants, and Paints.

**19.6.3.** The Dow Chemical Company has issued bulletin on Dow Latex 512-R, and improved latex for clay coated paper.

**19.6.4.** The Dow Chemical Company issued bulletin on Dow Latex 512-K for Exterior Masonry Paints.

**19.6.5.** The Dow Chemical Company has issued a data sheet describing the Dow Latexes (512-K, 512-R, 513-K) Styrene-Butadiene Copolymer Emulsions. Lists properties and suggested uses.

**19.6.6.** The Firestone Plastics Company has issued Sales Service Bulletin #B-1 describing the properties of Butaprene PL-1 latex, an emulsion of high styrene-butadiene copolymer.

cf: 19.3.1
36.6.1
40.1.1
40.1.6
44.2.2
44.2.4
44.2.5
49.1.7

Manufacturers:
American Polymer Corp.
Dow Chemical Company
Firestone Plastics Company
General Tire & Rubber Co.
The Goodyear Tire & Rubber Co., Inc.
Koppers Company, Inc.
Rubber Corporation of America

### Neoprene

**19.7.1.** Andersen & Arnold write on the aging stability of Neoprene latex. The most important cause of instability appears to be a slow evolution of chlorine by the polymer. Addition of dilute caustic improves the storage life. It is possible to predict the storage life of Neoprene latices. (*IEC-26*)

Manufacturer:
The American Resinous Chemicals Corp.

### Vinylidene Chloride Polymers

**19.8.** (No abstracts)
Manufacturer:
Dow Chemical Company

### Silicone

**19.9.1.** The General Electric Company has issued 5-page data sheet on SM-70, an oil-in-water emulsion of a methyl silicone fluid polymer.

Manufacturers:
Dow Chemical Corp.
General Electric Company

### Polyvinyl Chloride

**19.10.1.** The B. F. Goodrich Chemical Company has issued Service Bulletin L-4 describing properties and uses of Geon Resin and Plastic Latices; polyvinyl chloride resin emulsions.

**19.10.2.** The B. F. Goodrich Chemical Company has issued Service Bulletin L-5 describing properties and uses of Geon Latex 652, a polyvinyl chloride resin emulsion.

**19.10.3.** The B. F. Goodrich Chemical Company has issued Service Bulletin L-6 describing properties and uses of Geon Latex 450X167, a polyvinyl chloride resin emulsion.

Manufacturer:
B. F. Goodrich Chemical Company

### Petroleum Hydrocarbon

**19.11.1.** The Pennsylvania Industrial Chemical Corporation has issued 2-page bulletin describing properties and uses of Piccopale Emulsion, made from a blend of Piccopale 100 and D-165 Liquid Resin.

**19.11.2.** The Pennsylvania Industrial Chemical Corporation has issued 6-page bulletin on Piccopale Emulsion Paints.

Manufacturer:
Pennsylvania Industrial Chemical Corp.

### Natural Rubber (Latex)

**19.12.1.** The Rubber Corporation of America has issued 23-page booklet describing the properties and uses of their latex products (hevea and GR-S) and the RC plasticizers (ester-type plasticizers).

Manufacturers:
The General Tire & Rubber Company
Rubber Corporation of America

### Acrylic-Butadiene Copolymer

**19.13.** (No abstracts)

Manufacturer:
American Polymer Corp.

### Nitrogen-Containing Terpolymer

**19.14.** (No abstracts)

Manufacturer:
American Polymer Corp.

# PLASTICIZERS

## CHAPTER 20

# PLASTICIZERS

### General

**20.1.1.** Plasticizers have been usurping front center of the chemical markets stage. Price fluctuations—official and under-the-counter—have been the principal act. Plasticizer output and sales in 1953 not only were substantially better than 1952 volume, but also top the previous all-time highs chalked up in 1951. (CW-19)

**20.1.2.** As the plasticizer industry continues to broaden, it also becomes more complex. No longer can the end user of vinyls afford not to know the basic facts about the various members of the plasticizer families and what each has to offer.

Morris in the first of three articles discusses the types of plasticizers used with vinyl chloride film and sheeting. (MP-2)

**20.1.3.** Bergen, et al, in the second of three articles on plasticizers for vinyls, covers plasticizers for molding and extrusion compounds. (MP-5)

**20.1.4.** Deckel in the third article on plasticizers for vinyls covers plasticizers for vinyl dispersions. There are two basic systems used to make vinyl dispersions—vinyl resin dispersed in non-aqueous media and vinyl resin dispersed in water. The non-aqueous dispersions fall into two divisions—plastisols and organosols. The second group, water dispersions or vinyl latices, comprises several varieties, the major types being vinyl chloride polymers and copolymers, and polyvinyl acetate.

Although many of the principles of plasticizer selection are identical for both systems, there are also many differences which characterize and distinguish the two. (MP-10)

**20.1.5.** Emery Industries, Inc. has issued 34-page booklet describing properties and uses of Plastolein Plasticizers. These include azelates and polymeric types.

**20.1.6.** The Monsanto Chemical Company has issued 63-page Bulletin on "Monsanto Plasticizers—Uses, Properties, and Specifications." These include phthalates, phosphates, sulfonamides, phthalyl glycollates, adipates, chlorinated polyphenyls, and specialty plasticizers.

**20.1.7.** The Bakelite Company has issued 4-page Technical Bulletin No. 1 describing the applications and properties of Halowax Product 4004, a liquid chlorinated aliphatic hydrocarbon of medium viscosity and light color.

cf: 5.4.1

### Chemical

**20.2.1.** Greenspan & Gall describe a new series of vinyl plasticizers, epoxy fatty acid esters, distinguished by generally good overall plasticizer properties combined with unique attributes of their own. (IEC-25)

**20.2.2.** Gamrath, et al, describe the chemical and physical properties of the alkyl diaryl phosphates. They exhibit good stability and other excellent characteristics in comparison with esters in general. They are useful as plasticizers, especially for polyvinyl chloride and polyvinyl copolymers. (IEC-35)

**20.2.3.** Caldwell & Fowler devised a method for quantifying the standard potassium permanganate test applied to tricresyl phosphate. By measuring the color change of the $KMnO_4$ solution with a photoelectric photometer, subjective judgments are eliminated and more precise comparisons of materials by this test made possible. (ASTM-8)

**20.2.4.** Quackenbos, Reed, et al discuss plasticizer performance in vinyl resins. New test procedures have been developed for the loss of plasticizer into soapy water and into mineral oil, an apparatus has been devised whereby the sample is dragged through absorbent powder. This "rub-off" test of plasticizer loss simulates the treatment that must be withstood by vinyl upholstery. The study of the mechanism has shown why results for the soapy water, oil, and rub-off tests are often similar, why loss is proportional to the square root of time, under some conditions, a property of the plasticizer itself—for example, vapor pressure—governs loss from the plasticized sample. (IEC-61)

**20.2.5.** Process for the production of 1,3,5-ethylxylene, a plasticizer with a higher-than-ordinary softening point. Gives promise of improved polystyrene resins. Use of polydimethylstyrene resins has been limited by a low (212°F) softening point attributed to the presence of dehydrogenated o-ethylxylenes in the plasticizer-usually a mixture of ortho and meta ethylxylenes.

Process uses a Friedel-Crafts reaction to make high grade 1,3,5 ethylxylene. This could be the looked-for high melting plasticizer. Using it for resin production would minimize formation of the low melting intermediate usually encountered. This article is a report on U. S. 2,661,382—Arthur P. Lien & David A. McCauley as-

sig ed to Standard Oil Co. (Ind.) (C -14)

**0.2.6.** The Atlas Powder Compa y has issued 6-page technical bu letin describing G-2401, a noncr stallizing plasticizing polyol for m isture-conditioning.

**20.2.7.** The Atlas Powder Company has issued 25-page technical b lletin describing the use of Pycal P sticizers in Polyvinyl Acetate E mulsion adhesives.

**20.2.8.** The Atlas Powder Company has issued 6-page technical bulletin describing the properties and uses of Pycal 170—an auxiliary Low Temperature Plasticizer for Polyvinyl Chloride.

**20.2.9.** Godfrey L. Cabot Inc. has issued product data folders on Cabot Plasticizers Cabflex ODA and Cabflex ODP. The ODP is an iso-octyl decyl phthalate while the ODA is an iso-octyl decyl adipate.

**20.2.10.** The Carbide & Carbon Chemicals Company has issued 4-page bulletin F-8521 describing properties of Flexol Plasticizer 77-G: dipropylene Glycol Dibenzoate.

**20.2.11.** The Carbide & Carbon Chemicals Company has issued 5-page bulletin F-8622 describing the properties of Flexol Plasticizers 810 and 812, two new phthalate plasticizers.

**20.2.12.** Eastman Chemical Products, Inc. has issued 48-page booklet describing properties and uses of 11 Eastman Plasticizers. These include 7 phthalates, 2 adipates, triacetin and tributyrin.

**20.2.13.** The Monsanto Chemical Company has issued Technical Bulletin No. O-89 describing properties and uses of Santicizer 141, "the non-toxic plasticizer."

**20.2.14.** The Monsanto Chemical Company has issued Technical Bulletin No. 0-106 describing properties and uses of dioctyl adipate.

**20.2.15.** The Monsanto Chemical Company has issued Technical Bulletin No. 0-109 describing properties and uses of di (n-octyl, n-decyl) phthalate.

**20.2.16.** The Monsanto Chemical Company has issued Technical Bulletin No. 0-113 describing properties and uses of diisodecyl adipate.

**20.2.17.** The National Lead Company has issued 4-page bulletin on Dutch Boy Plasticizer NL A-54, a new phthalate plasticizer for vinyl resins.

**20.2.18.** The National Lead Company has issued 4-page bulletin on Dutch Boy Plasticizer NL F-21, a new general purpose vinyl plasticizer with unusually low volatility.

**20.2.19.** The National Lead Company has issued 4-page bulletin on Dutch Boy Plasticizer NL F-31, a new vinyl plasticizer with an excellent balance of properties.

**20.2.20.** The National Lead Company has issued 4-page bulletin on Dutch Boy Plasticizer NL F-41, a new low temperature vinyl plasticizer.

**20.2.21.** The Ohio-Apex Division has issued technical data sheets on Kronitex MX, Kronitex K-3, Dinopol IDO, and Adipol 810; new phosphate and adipate plasticizers.

**20.2.22.** The Pan American Chemicals Division has issued 10-page bulletin "Panaflex BN in Vinyl Chloride and Copolymer Resins". It finds extensive use as a co-plasticizer for vinyl resins.

**20.2.23.** Chas. Pfizer & Co., Inc. has issued Technical Bulletin No. 31 on "Citric Acid Esters as Plasticizers". Properties of Citric Acid Esters, plasticizer performance, experimental citric acid esters, and a bibliography are included.

**20.2.24.** The Pittsburgh Coke and Chemical Company has issued a technical bulletin on Pittsburgh PX Plasticizer PX-114, a new economical phthalate plasticizer.

**20.2.25.** The Pittsburgh Coke and Chemical Company has issued a technical bulletin on Pittsburgh PX Plasticizer PX-118, an isooctyl decyl phthalate.

**20.2.26.** The Tennessee Products and Chemical Corporation has issued a series of bulletins describing the Benzoflexes, a series of dibenzoate ester plasticizers.

**20.2.27.** The Witco Chemical Company has issued Bulletin E-6 describing properties and uses of Witco dioctyl phthalate.

**20.2.28.** The Witco Chemical Company has issued Bulletin E-7 describing properties and uses of Witco di-iso-octyl phthalate.

**20.2.29.** The Monsanto Chemical Company now makes two low-temperature plasticizers for polyvinyl chloride resins; DOA (dioctyl adipate) and DNODP (di-n-octyl n-decyl phthalate).

**20.2.30.** Pittsburgh PX-114, a new low-cost phthalate plasticizer from Pittsburgh Coke and Chemical is said to be compatible with other plasticizers. PX-114 (decyl butyl phthalate) will give vinyl plastics good low-temperature flexibility, good mechanical properties, and permanence.

cf: 19.12.1
20.1.5
20.1.6
37.2.2

Manufacturers:
Advance Solvents & Chemical Corp.
Atlas Powder Company
Baker Castor Oil Company
Barrett Division
Godfrey L. Cabot, Inc.
Carbide & Carbon Chemicals Company
Commercial Solvents Corporation
Dewey & Almy Chemical Company
Diamond Alkali Company
Eastman Chemical Products, Inc.
Emery Industries, Inc.
Hercules Powder Company
Monsanto Chemical Company
National Lead Company
Ohio-Apex Division
Pan American Chemicals Division
Chas. Pfizer & Company, Inc.
Pittsburgh Coke & Chemical Company
Rohm & Haas Company
Rubber Corporation of America
Witco Chemical Company
Wyandotte Chemicals Corp.

### Resinous

**20.3.1.** Aelony correlates the structure of aromatic sulfonamides and their performance as plasticizers and waxes. Several series of compounds were synthesized and tested for plasticizing action on vinyl resins and for waxlike properties. (IEC-46)

**20.3.2.** The Pittsburgh Coke & Chemical Company has issued a technical bulletin on Pittsburgh PX-800 Epoxy; a highly compatible polymeric-type (epoxy) plasticizer for use with vinyl resins.

cf: 3.1.6
20.1.5
20.1.6
20.2.4

Manufacturers:
Baker Castor Oil Company
Cargill, Inc.
Diamond Alkali Company
Emery Industries Inc.
General Electric Company
Hercules Powder Company
Monsanto Chemical Company
Pan American Chemicals
Pittsburgh Coke & Chemical Company
Rohm & Haas Company
Rubber Corporation of America

### Plasticizing Oils

**20.4** (No Abstracts)

Manufacturers:
Archer-Daniels-Midland Company
Baker Castor Oil Company
Pacific Vegetable Oil Corporation

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**BP-192-D.** A water dispersible pigment for resin-emulsion and latex base paints.

**BT-297-D.** A green-shade, full strength pigment that produces attractive two-tone effects when metallized.

**BW-372-P.** A standardized water paste for emulsion paints.

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## PHTHALOCYANINE GREENS

| MONASTRAL® | "RAMAPO" |
|---|---|
| GT-674-D | GP-501-D |

Blue-tone greens with brilliance and strength, great stability and chemical inertness.

| MONASTRAL® | "RAMAPO" |
|---|---|
| GT-751-D | GP-755-D |

Yellow-tone greens that give greater blending flexibility—permits a range of brighter greens.

**MONASTRAL® GW-749-P.** A standardized water paste for emulsion paints.

## MOLYBDATE ORANGES

**YE-421-D.** A high quality pigment having exceptional masstone brilliance and tinting strength; also a versatile blending pigment.

**YE-637-D.** Unsurpassed resistance to darkening from exposure—essential where the ultimate in lightfastness is needed.

## SHADING YELLOW

**Y-493-D.** Just this *one* Shading Yellow—blended with standard Milori Blues—is all you need to produce greens fully equal in quality to the more expensive Chrome Greens.

## CHROME YELLOWS

| LIGHT | "EXCELSIOR" | MEDIUM |
|---|---|---|
| Y-433-D | Y-434-D | Y-469-D |

Lightfast, brilliant, easy to disperse. These pigments mix readily to provide a smooth, uniform mill base. Careful and complete standardization assures uniform quality.

## ZINC YELLOW

**Y-539-D.** HIGH CHROMATE TYPE—Meets the requirements of all Zinc Yellow specifications. Gives lightfast decorative finishes . . . non-staining in industrial atmospheres.

## GREEN GOLD

**YT-562-D.** Has excellent color retention in full shade, tints and metallics. Produces exceptionally brilliant greens when blended with "Monastral" phthalocyanines.

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**R-510.** This grade is chalk-resistant and has outstanding dispersion properties. It's an ideal all-purpose grade for architectural finishes.

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**E. I. du Pont de Nemours & Co. (Inc.)**
**Pigments Department Wilmington 98, Del.**

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CHAPTER 21

# GENERAL PIGMENTS

### General

**21.1.1.** Kienle & Maresh reproduce electron, and some optical, micrographs to illustrate the influence on the optical properties of films, of the following pigment properties: refractive index, light absorption, particle shape and size, degree and method of deflocculation, weathering, gloss and surface inperfections. (JOCCA-9)

**21.1.2.** Urich reviews progress and recent developments in inorganic colors. Included are chrome yellows, molybdate orange, chrome greens, zinc yellow, & iron oxides. (PVP-5)

**21.1.3.** Permut reviews organic colors. Included are reds (toluidene, lithol etc.), maroons, yellows (hansa & green gold), orange (permanent, ortho), greens (phthalocyanine), & blues (phthalocyanine & indanthiene). Water dispersible pigments, and water dispersions are discussed. (PVP-6)

**21.1.4.** Morris reviews pigments for industrial finishes. Traditional white and black are being replaced by all of the rainbow's many hues, in both pastels and deep-tones. (PVP-12)

**21.1.5.** Morgans reports on pigment progress. In addition to the continuing interest in the established pigments, there has been an increased amount of work devoted to the preparation of treated pigments, which are more readily dispersible for use in either orthodox or other paint vehicles. In particular, the increasing demand for emulsion paints has focused attention on the advantages to be gained if a wider range of pigments easily dispersible in water were available. Similarly, very fine grinding of pigments and extenders continues to attract considerable attention, and a review of the newer types of colloid mills and disintegrators has been noted. (PM-13)

**21.1.6.** An unusual example of a modern scientific industry operating in what is still little more than a large village is the Yate Branch of Golden Valley Colours Ltd. This article briefly describes their manufacture of pigments. (PM-29)

**21.1.7.** Madson discusses pigmentation of flat paints. The following are presented:

1. pigmentation for flat paints having excellent color uniformity over surfaces of varying porosity.
2. a method of recording color uniformity data and a simplified method of studying paint problems.
3. data on the effect of blends of $TiO_2$ and titanium calcium pigmentation of flat paints.
4. a method for studying paints at constant titanium dioxide pigment content and varying P.V.C.
5. results of study on the effect of extenders on hiding power, brightness and pigment volume concentration of flats.
6. a brief review of the use of odorless vehicles and solvents in flat paints. (PVP-48)

**21.1.8.** Parker describes the pigmentation of industrial finishes. The problem of pigmentation can be divided into two broad groups, ie, durable and non-durable. Good package stability, application properties, adhesion, flow, leveling, gloss, hiding, and initial film characteristics are required in both. (OD-45)

**21.1.9.** North described colored pigments in an address to the Leeds Junior Branch of the Society of Dyers and Colourists. Apart from the resistance to various destructive agencies which arise from the chemical nature of the pigment, physical condition, crystal structure, surface properties and other physical properties all take part in determining the behaviour of the pigment. (PM-65)

**21.1.10.** Rowland reviews the progress in the application of pigment colors to textiles. Pigment colors are assuming an increasingly important role in the decoration of textile fabrics. The most recent developments (O/W printing systems, printing on synthetic fibers nylon crinkle, tipping and inlay printing, glass printing, and aniline black carriers) are the products of programs started two to five years ago. Work in the future will include continued improvement of the fastness of W/O and O/W systems to crocking, washing, dry cleaning, as well as improvements in formulation, development of new pigments and resins, formulation of pigmented colors for new fibers, and special products to meet new end-use requirements. (IR-2)

**21.1.11.** Peacock discusses types of colorants for plastics. Hue, resistance to heat, resistance to light, resistance to bleeding, resistance to chemicals and color index numbers are covered in 10 tables including red, orange, yellow, green, blue and violet, brown, black, and white pigments, and oil-soluble and water-soluble dyes. (MP-28)

**21.1.12.** The New York Club presents a study of the pigmentation of emulsion systems. The study was based on butadiene-polystyrene and on plasticized polystyrene systems at 15, 30, and 45%

P.V.C. The following types of preparation were included:

1. three-roller mill
2. high-speed mixer
3. high-speed stone mill
4. Colloid mill
5. pebble mill

Studies were made on package stability and film characteristics. (POCR-6)

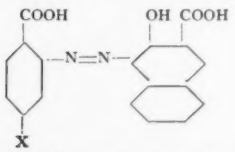
**21.1.13.** Singer presents the first part of Chapter VII in his "Fundamentals of Paint, Varnish, and Lacquer Technology" on pigments. (APJ-4)

**21.1.14.** Singer presents part II of Chapter VII of Fundamentals of Paint, Varnish, and Lacquer Technology. The chapter covers pigments, and this part discusses color pigments and metallic pigments. (APJ-8)

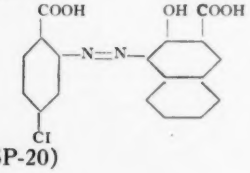
**21.1.15.** Wakefield reviews recent developments in chemical colors, including red, orange, yellow, green, blue and aqueous pigment dispersions. (POCR-26)

**21.1.16.** Eight grate and hopper magnets save $6,000 annually at color pigment plant of Kentucky Color & Chemical Company. The magnets remove particles of rust weighing fractions of an ounce, large bolts and iron scrap which ordinarily contribute to the three major causes of pigment production problems: product contamination, machinery damage, and fire-breakouts. (PIM-10)

**21.1.17.** As a new insoluble azo maroon pigment, the manganese salt of the azo dyestuff having the formula in which X is a substituent selected from the group consisting of halogen and nitro.




A durable synthetic alkyd resin coating composition containing as pigmenting ingredients a minor proportion of powdered aluminum and a major proportion of the manganese salt of the insoluble azo maroon dyestuff having the formula:




(USP-20)

**21.1.18.** A pigment comprising discrete particles in solid state of clay individually coated with a condensation product of formaldehyde and at least one material of the group consisting of (*a*) urea, (*b*) phenol and (*c*) melamine, which condensation product is capable of further advancement, prepared by spray-drying an aqueous mixture of clay and one of the group consisting of (*i*) a water solution of said condensation product and (*ii*) a water dispersion of said condensation product. (USP-109)

**21.1.19.** E. I. du Pont de Nemours & Co. (Inc.) has issued Technical Service Bulletin No. 20—Dupont Pigment Colors for Emulsion Paints.

cf: 2.2.2
5.4.1
38.1.10
38.2.8
38.3.1
39.1.2
39.1.3
40.1.4
40.1.5
46.3.1
50.1.2
50.1.3
50.3.1
50.8.1

### Color and Color Cards

**21.2.1.** Willmer notes that surface colors not only depend on physical factors, such as the composition of the incident light and the nature and texture of the surface, but also on physiological factors which modify the performance of the receptive mechanisms in the eye. Some anomalies of color perception which depend on such physiological factors can be demonstrated. (JOCCA-2)

**21.2.2.** The application of color to buildings is discussed by Hurst, with special emphasis on contempory trends. Some consideration of the three-dimensional aspect of color and color solids is given, with brief reference to the Ostwald and Munsell systems. The scientists' and artists' conceptions of color are compared. The functional use of color in buildings and the application of "selective" color in relation to the natural lighting in a room, and the avoidance of unwanted discords, are outlined and the effects of lighting on color pointed out. (JOCCA-22)

**21.2.3.** Corcoran discusses the factors which determine the color which results when two or more pigments are mixed. It is assumed throughout that there is no chemical reaction between the substances, and that the pigments are ground together sufficiently fine to prevent either color from showing separately. (PM-41)

**21.2.4.** Engel discusses the selection of colors and color design for painting. The author discusses the language of color, color design composition, contrasting factors, psychological factors, the mechanics of color selection, procedure in color selection, and keys to judgment. (OF-38)

**21.2.5.** Mann presents a color forecast for 1954. The impact of various magazines on color trends in home decoration is described. Color is being de-emphasized in favor of white, neutrals and pastels. (APJ-6)

**21.2.6.** Hunter discusses the practical application of color theory to paint manufacture. The field of color is a broad one, and many problems enter into the introduction of color in the paint production picture. (APJ-36)

**21.2.7.** Few of us realize the important part color cards, chips, books, and chipped displays, play in selling every kind of paint. About 95% of all trade sales and industrial maintenance finishes are sold through this medium. Painters and industrial salesmen must be equipped with an effective presentation of color.

This article discusses the production of color cards, etc., by Carl Gorr Color Card, Inc. (APJ-45)

**21.2.8.** The method of blending red, yellow and blue coloring materials to a desired color intensity and shade comprising determining the reciprocal color intensity of the given coloring components of the desired color to be obtained and then blending the colors quantitatively in the ratio of their reciprocal color intensities to produce the desired shade and hue, said reciprocal color intensity being determined by measuring the minimum critical quantity of the coloring material of unknown coloring power required to produce a coloring effect upon a substantially stronger color containing a shade modifying quantity of a weaker color other than the unknown color-

ing material other than merely deepening the color thereof, said stronger color being selected from the group consisting of bright red, bright yellow and bright blue, and said unknown color being a color of this group other than the stronger color. (USP-79)

cf: 50.2.12
50.2.15
Manufacturer:
Matherson-Selig Company

**Dyes**

**21.3.1.** Bradley & Kronowitt, in a staff-industry collaborative report, discuss the manufacture of anthraquinine vat dyes. This article describes in detail the manufacture of Cibanone Brown BR, a carbazole derivative of anthraquinone. The Ciba plant at Toms River is discussed, where more than 35 different dyestuffs can be produced. (IEC-59)

**21.3.2.** Woislawski determined, spectro-photometrically, the ionization constants of 14 basic dyes belonging to 5 chemical classes: azo, azines, xanthenes, oxazines and thiazines. The values were compared with those obtained by titration in water and in 50% unbuffered alcohol. Fairly good agreement was obtained for Nile Blue A, Bismark Brown Y, Rhodamine B, Chrysoiden Y, Neutral Red, and Pyronine B. Higher values were found by the spectrophotometric method than by the other two methods for the remaining dyes. The data indicate that the ionization constants not only vary with the method and medium, but also that the order of basicity is different in different media. (JACS-7)

**21.3.3.** A solution comprising dioxane, water, at least one oil-soluble organic dye and from 0.5% to 1.5% by weight of diethyl aminoethanol. (USP-52)

cf: 21.1.11
39.1.44
Manufacturers:
American Cyanamid Company
Arnold, Hoffman & Company, Inc.
Ciba Company, Inc.
E. I. duPont de Nemours & Company, Inc.
Eastman Chemical Products, Inc.
General Dyestuff Corporation
Peerless Color Company, Inc.

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## CHAPTER 22

# WHITE PIGMENTS

### General

**22.1.1.** Melsheimer reviews, in a general way, the existing test methods for tinting strength of white pigments. The philosophy of testing opaque white pigments for tinctorial strength is considered and factors influencing the relative strength discussed. Relative tinting strength tests should be made maintaining equal opaque white pigment volume concentration in all comparative tests by incorporating, where necessary, a substantially transparent extender with highly opaque pigments, like pure $TiO_2$, so that the evaluation is made at normal commercial concentrations. Also, to be meaningful, comparative tests must be carried out at equal opaque pigment volume concentration. (ASTM-5)

**22.1.2.** A pigment consisting essentially of lead and magnesium compounds in chemical association resulting from reaction of lead oxide and magnesium carbonate in the presence of water, the said pigment having a lead content of from approximately 20 to 70% by weight and being characterized by whiteness comparable to the whiteness of basic carbonate white lead, and a higher bulking value than basic carbonate white lead. (USP-122)

cf: 21.1.8
50.2.7

### Titanium Dioxide

**22.2.1.** Anderson reviews progress and recent developments in titanium dioxide pigments. The rutile crystal structure is foremost because it best functions in the essential effects of a white pigment namely to whiten, brighten, opacify and protect. (PVP-2)

**22.2.2.** Weber describes the titanium operations at Sorel, Quebec. The story of the Lac Tio project began in 1941 when a huge deposit of titanium bearing ore was discovered along the northern rim of the Gulf of St. Lawrence. Not until late in the war was anything really done to exploit the Canadian ore deposit. Locationally the entire complex of mine, shipping sites, and plant is good. In 1953, 129,823 gross tons of slag (70% TiO2 were shipped, and the full benefits from this enterprise have not yet been fulfilled, nor will its final achievements be realized for years to come. (APJ-48)

**22.2.3.** In a process of preparing a titanium dioxide pigment possessing improved resistance to chalking wherein the particles of said pigment in aqueous slurry are coated with a hydrous aluminum oxide, the weight of said oxide as $Al_2O_3$ being about 0.5% to about 5% of the weight of said pigment, and said coated particles are then heated, the step of heating the thus coated pigment between about 500° C. and the higher temperature at which the pigment particles increase in size, until the hydrous aluminum oxide is at least partially dehydrated. (USP-100)

**22.2.4.** The American Cyanamid Company has issued Calco Technical Bulletin No. 905 on Unitane OR-640 Titanium Dioxide Pigment—A highly chalk resistant type for exterior house paints, enamels, lacquers and all tinted exterior finishes.

**22.2.5.** The American Cyanamid Company has issued Calco Technical Bulletin No. 906—Dispersion of Titanium Dioxide Using the Intensive Mixing Procedure.

**22.2.6.** The Titanium Pigment Corporation has issued a total of 64 reprints in their series "Technical Tips from Titanox".

cf: 21.1.11
22.3.2
35.5.3
36.6.1
38.1.5

Manufacturers:
American Cyanamid Company
E. I. duPont de Nemours & Company, Inc.
The Glidden Company
Titanium Pigment Corp.

### Zinc Sulphide & Zinc Oxide

**22.3.1.** Werthan reviews progress and recent developments in zinc pigments. Included are zinc sulphide and zinc oxide as white pigments and zinc oxide-zinc dust and zinc chromate as metal-protective pigments. (PVP-1)

**22.3.2.** A new photo-electric method has been described by Drs. W. Grassmann and H. Clausen of the Sachtleben A. G. research department. The accuracy of the measurements is of the same order as with the usual methods, namely ±2%. However the photoelectric method has the great advantage of being objective, and requires only one preparation of sample and measurement. (PM-14)

**22.3.3.** The New Jersey Zinc Sales Company (Inc.) has issued Service Technical Bulletin listing formula H-34200-YE: Iron Oxide —Zinc Oxide Ready Mixed Paint for Priming and Finishing Wood & Metal Surfaces.

Manufacturers:
American Zinc Sales Company
The Eagle-Picher Lead Company
The Glidden Company
The New Jersey Zinc Company
St. Joseph Lead Company
Smith Chemical & Color Company

## White Lead

**22.4.1.** White lead pigments are reviewed in an article by the Research Dept. of the National Lead Co. There are a number of lead compounds from which the paint chemist may choose for study to improve the life of paint films. (PVP-3)

cf: 22.3.2
Manufacturers:
The Eagle-Picher Lead Company
National Lead Company

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## CHAPTER 23

# EXTENDER PIGMENTS

### General

**23.1.1.** Wheeler reviews extender pigments. Advances have changed the status of extenders. No longer are they merely fillers, inerts to cheapen cost but they are prime factors in the excellent performance of paints today. (PVP-8)

**23.1.2.** A panel discussion on developments in extender pigment was held at New York University (March 24, 1954). The effect of such factors as particle size and shape, surface characteristics and lack of opacifying action were illustrated and discussed. The acicular and lamellar are the only two shapes that might be considered to have a tendency to reinforce a paint film. It is also possible to control the consistency of paints by the proper choice of size and shape of a particular extender pigment. (PVP-33)

**23.1.3.** Johnson discusses the need for extenders. In describing paint pigments the terms "inert", "extender", and "filler" are commonly thought to refer to materials used only to lower the quality and cost of finishes in which they are used. Sometimes this is true, but more often, their use is beneficial, and in many cases vital to the formulation of a product of sufficiently high quality to meet requirements. Extenders control porosity, mica increases weathering resistance, talc is used to control the flow characteristics of paint, extenders are vital to production of flat and semi-gloss paints, mica reduces penetration into the film. (CPVM-10)

cf: 19.4.12
19.4.17

### Mica

**23.2.1.** The Wet Ground Mica Association, Inc. has issued Technical Bulletin No. 15—Studies on the Behavior of Mica as a Pigment Material in Latex Paints. (Part II).

**23.2.2.** The Wet Ground Mica Association, Inc. has issued Technical Bulletin No. 16—Studies on the Behavior of Mica as a Pigment Material in Latex Paints—PartIII.

**23.2.3.** The Wet Ground Mica Association, Inc. has issued Technical Bulletin No. 17—Studies on the Effect of Mica in Latex Alkyd Paints.

**23.2.4.** The Wet Ground Mica Association, Inc., has issued Technical Bulletin No. 18—The Use of Wet Ground Mica in Vinyl Acetate Co-Polymer Latex Paint—Part I.

**23.2.5.** The Wet Ground Mica Association, Inc., has issued Technical Bulletin No. 19—The Use of Wet Ground Mica in Vinyl Acetate Co-Polymer Latex Alkyd Paint—Part II.

cf: 23.1.2
Manufacturers:
Concord Mica Corporation
The English Mica Company
Franklin Mineral Products Company
Hayden Mica Company
Mineralite Sales Corporation
U. S. Mica Company, Inc.

### Silica

**23.3.1.** That abuzz of activity in the ultra-fine silica field has already resulted in one new plant and several new products. More may be in the offing. Godfrey L. Cabot, Dow Corning, DuPont, General Electric, Columbia-Southern, and Monsanto are all in there pitching. (CE-6)

**23.3.2.** The Davison Chemical Company has issued Product Data Sheets describing properties and uses of Syloid 72, 244, & 978, silica pigment, silica gel and synthetic finely-sized silica.

**23.3.3.** Johns-Manville Products Corporation has issued 16-page booklet describing properties and uses of Johns-Manville Celite flatting agents and pigment extenders. Celite inert diatomite pigments step up performance of protective and decorative coatings.

**23.3.4.** The Monsanto Chemical Company has issued 16-page bulletin describing properties and uses of Santocel 54 for flatting. A preliminary bulletin (I-125) was issued earlier in the year describing this silica aerogel extender and flatting pigment.

Manufacturers:
The Davidson Chemical Corporation
Dow Corning Corporation
Great Lakes Carbon Corporation
Innis, Speiden & Company, Inc.
Johns-Manville Products Corp.
Monsanto Chemical Company
Smith Chemical & Color Company
Tamms Industries, Inc.
C. K. Williams & Company

### Calcium Carbonate

**23.4.1.** McCleary & Kummer report on calcium carbonate extender pigments in exterior masonry paints. The paper includes a) a systematic evaluation of the various grades of ground calcium carbonate; b) a formulation study in both whites and tints of low and high P.V.C. covering two different grades of ground calcium carbonate having low absorption properties; c) a critical evaluation in whites and tints of ground pigments, similarly produced from high quality calcite originating from widely different geographical sources; d) a critical evaluation of preferred

exterior white house paints containing only $CaCO_3$ as extender pigment against seven first quality self cleaning whites; e) a study in which several grades of $CaCO_3$ were formulated into white and tinted exterior paints where other vehicles replace a part or all of the linseed oil commonly used; f) a study in which ground $CaCO_3$ or $CaCO_3$ in combination with varying amounts of a high brightness thin flake mica were used along with varied amounts of 35% Pb-ZnO or with acicular ZnO; g) a series of six data tables illustrating the type of formulations which went on exposure during the summer of 1952.

The conclusions drawn are as follows:

1. Ground calcium carbonate pigments can be quite successfully used in the manufacture of high quality exterior house paints which have very favorable raw material costs.

2. Ground calcium carbonate pigments which contain substantially no particles above the 25 micron range and yet display low absorption give the best overall results in exterior house paints.

3. The use of ground calcium carbonate as the major or sole extender pigment, renders it unnecessary to use the customary quantities of Pb-ZnO or acicular ZnO in order to have satisfacotry mildew resistance in exterior house paints. (OD-1)

**23.4.2.** The Witco Chemical Company has issued Bulletin P-3 describing Witcarb R in Enamels-Improvement of Gloss and Body. Witcarb R is an ultrafine precipitated calcium carbonate.

**23.4.3.** The Witco Chemical Company has issued Bulletin W-1 describing Witcarb Fillers for Polyester Resins. Witcarb is a finely divided precipitated calcium carbonate.

**23.4.4.** The Witco Chemical Company has issued Bulletin #54-3 describing the use of Witcarb pure calcium carbonate in paints

**23.4.5.** The Wyandotte Chemicals Corporation has issued 24-page Technical Bulletin on Purecal in Paints. Use of calcium carbonate in paints is discussed.

cf: 23.1.2
35.5.3
38.3.1

Manufacturers:
Carbola Chemical Company
Diamond Alkali Company
National Lead Company
Smith Chemical & Color Company
Tamms Industries, Inc.
C. K. Williams & Company
Witco Chemical Company
Wyandotte Chemicals Corp.

### Barytes

**23.5.** (No Abstracts)

Manufacturers:
National Lead Company
Smith Chemical & Color Company
C. K. Williams & Company

### Magnesium Silicate

**23.6.** (No Abstracts)

Manufacturers:
Innis, Speiden & Company, Inc.
Kraft Chemical Company, Inc.
Smith Chemical & Color Company
Tamms Industries, Inc.
R. T. Vanderbilt Company

### Aluminum Silicate

**23.7.** (No Abstracts)

Manufacturers:
Burgess Pigment Company
Innis, Speiden & Company, Inc.
Minerals & Chemicals Corp. of America

### Calcium Metasilicate

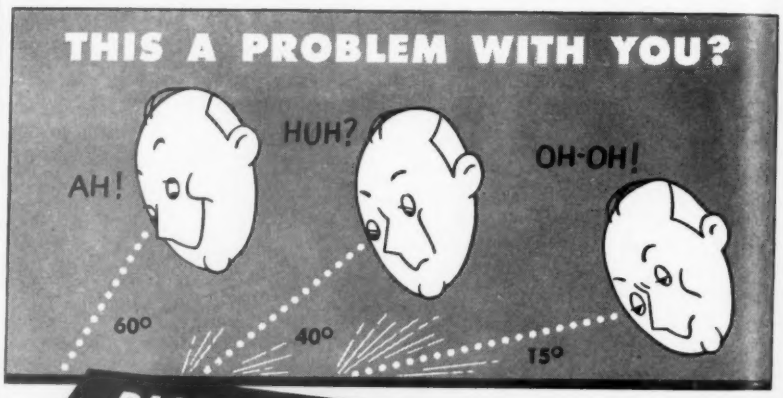
**23.8.** (No Abstracts)

Manufacturer:
Godfrey L. Cabot, Inc.

### Clay

**23.9.** (No Abstracts)

Manufacturers:
Georgia Kaolin Co.
H. C. Spinks Clay Company, Inc.
R. T. Vanderbilt Company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Also, in producing egg shell or semi-gloss finishes, Dicalite Extenders and Flatting Agents give accurate and reliable control of gloss to any degree desired—and the control is easy, not "critical." Dicalite is available in several grades, with a wide range of properties to fit them for the production of all kinds of finishes. Data and suggested formulations on request. Write for Bulletin C-21.

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## CHAPTER 24

# IRON OXIDES

### General

**24.1.1.** Cauterman discusses the manufacture of iron oxide pigments. More synthetic iron oxide pigments are being used as improved manufacturing techniques turn out a better product. (CPVM-37)

### Yellow

**24.2.** (No Abstracts)

Manufacturers:
Columbian Carbon Company
Mineral Pigments Corp.
Reichard-Coulston, Inc.
Smith Chemical & Color Company
Tamms Industries, Inc.
C. K. Williams & Company

### Red

**24.3.** (No Abstracts)

Manufacturers:
Columbian Carbon Company
Mineral Pigments Corp.
Reichard-Coulston, Inc.
Smith Chemical & Color Company
Tamms Industries, Inc.
C. K. Williams & Company

### Tan

**24.4.** (No Abstracts)

Manufacturers:
Columbian Carbon Company
Mineral Pigments Corporation

### Brown

**24.5.** (No Abstracts)

Manufacturers:
Columbian Carbon Company
Mineral Pigments Corp.
Reichard-Coulston, Inc.
Smith Chemical & Color Company
C. K. Williams & Company

### Black

**24.6.** (No Abstracts)

Manufacturers:
Columbian Carbon Company
Mineral Pigments Corp.
Smith Chemical & Color Company
C. K. Williams & Company

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## CHAPTER 25

# RED PIGMENTS

### General

**25.1.1.** The Standard Ultramarine & Color Company has issued 4 technical bulletins describing properties and uses of Molora Maroon RE-6305, Molora Maroon RE-6370, BON Maroon Medium RM-6340, and Concord Maroon RE-6375. These are all BON type toners.

**25.1.2.** The Standard Ultramarine & Color Company has issued a technical bulletin describing properties and uses of Dixie Reds for Protective and Decorative Coatings. These are permanent BON toners.

**25.1.3.** The Standard Ultramarine & Color Company has issued technical bulletin on Duratone Reds, a series of new organic red pigments developed as an outgrowth of the development of a new type manganese BON Maroon Toner.

cf: 21.1.3
21.1.8
21.1.11
38.1.5
50.2.7

Manufacturers:
American Cyanamid Company
Ansbacher-Siegle Corp.
E. I. duPont de Nemours & Company, Inc.
Fine Colors Company
General Color Company
The Glidden Company
Holland Color & Chemical Company
Imperial Paper & Color Corp.
Kentucky Color & Chemical Company
Mineral Pigments Corp.
The Sherwin-Williams Company
Smith Chemical & Color Company
Standard Ultramarine & Color Company

### Toluidine Red

**25.2.1.** The Standard Ultramarine & Color Company has issued data sheet describing properties of High-Gloss Toluidine Toners.

cf: 21.1.3

Manufacturers:
American Cyanamid Company
Ansbacher-Siegle Corp.
E. I. duPont de Nemours & Co., Inc.
Fine Colors Company
Holland Color & Chemical Company
Imperial Paper & Color Corp.
Kentucky Color & Chemical Company
Mineral Pigments Corp.
The Sherwin-Williams Company
Standard Ultramarine & Color Company

### Lithol Red

**25.3.** (No Abstracts)

cf: 21.1.3
Manufacturers:
American Cyanamid Company
Ansbacher-Siegle Corp.
E. I. duPont de Nemours & Company, Inc.
Holland Color & Chemical Company
Imperial Paper & Color Corp.
Kentucky Color & Chemical Company
Standard Ultramarine & Color Company

### Para Red

**25.4.** (No Abstracts)

cf: 21.1.3
Manufacturers:
American Cyanamid Company
Ansbacher-Siegle Corp.
E. I. duPont de Nemours & Company, Inc.
Holland Color & Chemical Company
Imperial Paper & Color Corp.
Kentucky Color & Chemical Company
Standard Ultramarine & Color Company

### Cadmium Red

**25.5.** (No Abstracts)

cf: 26.3.1
Manufacturers:
American Cyanamid Company
General Color Company
Imperial Paper & Color Corp.
Kentucky Color & Chemical Company
Smith Chemical & Color Company

## CHAPTER 26

# YELLOW AND ORANGE PIGMENTS

### General

**26.1.** (No abstracts)

cf: 21.1.8
21.1.11
50.2.7
Manufacturers:
American Cyanamid Company
Ansbacher-Siegle Corp.
E. I. duPont de Nemours & Co., Inc.
Fine Colors Company
The Glidden Company
The Harshaw Chemical Company
Holland Color & Chemical Company
Imperial Paper & Color Corp.
Kentucky Color & Chemical Company
Mineral Pigments Corp.
The Sherwin-Williams Company
Smith Chemical & Color Company
Standard Ultramarine & Color Company

### Chrome Yellow

**26.2.1.** Kentucky Color & Chemical Co., Inc. has issued Customer Service Department Report on Grellow #3850, a green-shade, light chrome yellow.

cf: 21.1.2
38.1.5
Manufacturers:
American Cyanamid Company
Ansbacher-Siegle Corp.
E. I. duPont de Nemours & Co., Inc.
Imperial Paper & Color Corp.
Kentucky Color & Chemical Company
Mineral Pigments Corp.

### Cadmium Yellow

**26.3.1.** Pigments derived from cadmium sulphide, cadmium sulphoselenides and co-precipitants are described by Curtis and Wright. Methods of manufacture are outlined, and data given on analytical methods both qualitative and quantative, color and particle size distribution.

The uses of these pigments in paints, artists' colors, rubber, plastics, printing inks, wallpaper, leather, glass and vitreous enamels are briefly discussed. (JOCCA-18)

Manufacturers:
American Cyanamid Company
Imperial Paper & Color Corp.
Kentucky Color & Chemical Company
Smith Chemical & Color Company

### Organic Oranges

**26.4.** (No abstracts)

cf: 21.1.3
Manufacturers:
American Cyanamid Company
Ansbacher-Siegle Corp.
E. I. duPont de Nemours & Co., Inc.
Holland Color & Chemical Company
Imperial Paper & Color Corp.
Kentucky Color & Chemical Company
Mineral Pigments Corp.
The Sherwin-Williams Company
Standard Ultramarine & Color Company

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## CHAPTER 27

# GREEN PIGMENTS

### General

**27.1.** (No abstracts)

cf: 21.1.8
21.1.11
Manufacturers:
American Cyanamid Company
Ansbacher-Siegle Corp.
E. I. duPont de Nemours & Co., Inc.
Holland Color & Chemical Company
Imperial Paper & Color Corp.
Kentucky Color & Chemical Company
Mineral Pigments Corp.
The Sherwin-Williams Company
Smith Chemical & Color Company

### Chrome Green

**27.2.** (No abstracts)

cf: 21.1.2
Manufacturers:
American Cyanamid Company
Ansbacher-Siegle Corp.
E. I. duPont de Nemours & Co., Inc.
Imperial Paper & Color Corp.
Kentucky Color & Chemical Company
Mineral Pigments Corp.
Smith Chemical & Color Company

### Phthalocyanine Green

**27.3.1.** The method of producing a tinctorially strong, metallized phthalocyanine pigment in a finely divided pigmentary state which comprises subjecting a metallized phthalocyanine pigment to grinding in the presence of an organic liquid with a solid grinding aid having a surface area of at least 0.14 square meter per gram, the quantity of organic liquid present being sufficient to convert the pigment-grinding aid mixture to a doughy mass, and thereafter isolating the pigment from the ground mass. (USP-95)

**27.3.2.** New York Color & Chemical Co. (Inc.) issued a bulletin describing Nycolime Colors—specially designed for the cement and allied industries.

cf: 21.1.3
38.1.5
Manufacturers:
American Cyanamid Company
Ansbacher-Siegle Corp.
E. I. duPont de Nemours & Co., Inc.
Fine Colors Company
General Dyestuff Corp.
Holland Color & Chemical Company
Imperial Paper & Color Corp.
Kentucky Color & Chemical Company
Mineral Pigments Corp.
New York Color & Chemical Company
Standard Ultramarine & Color Company

### Chromium Oxide

**27.4.** (No abstracts)

Manufacturers:
Imperial Paper & Color Corp.
Mineral Pigments Corp.
C. K. Williams & Company
Smith Chemical & Color Company

## CHAPTER 28

# BLUE AND VIOLET PIGMENTS

### General

**28.1.** (No abstracts)

cf: 21.1.8
21.1.11
Manufacturers:
American Cyanamid Company
Ansbacher-Siegle Corp.
E. I. duPont de Nemours & Co., Inc.
Imperial Paper & Color Corp.
Kentucky Color & Chemical Company
The Sherwin-Williams Company
Smith Chemical & Color Company
Standard Ultramarine & Color Company

### Phthalocyanine Blue

**28.2.1.** Broullard & Mutaffis studied the crystallization of phthalocyanine blue. This crystallization tendency contributes to loss of strength and brilliance experienced on aging paint, enamel or lacquer systems containing phthalocyanine blue. Further study has shown that certain solvents and particularly the aromatics in the systems are responsible for this crystallization. The realistic evaluation of phthalocyanine blue with reference to solvent stability cannot be made by simple microscopic examination of the pigment in a solvent. This evaluation must be done by a test closely related to end use and preferably measured by sensitive instrument such as a spectrophotometer. (PVP-43)

**28.2.2.** Kentucky Color & Chemical Co., Inc. has issued Customer Service Department Report on Zulu Blue N-F No. 4857 a non-flocculating phthalocyanine blue.

cf: 21.1.3
27.3.1
Manufacturers:
American Cyanamid Company
Ansbacher-Siegle Corp.
E. I. duPont de Nemours & Co., Inc.
Fine Colors Company
General Dyestuff Corp.
Holland Color & Chemical Company
Imperial Paper & Color Corp.
Kentucky Color & Chemical Company
Mineral Pigments Corp.
New York Color & Chemical Company
Standard Ultramarine & Color Company

### Ultramarine Blue

**28.3.1.** Kumins discusses ultramarine blue. Following a short history he discusses its uses, color characteristics and comparison with other blues, structural chemistry, method of manufacture, later developments, chemistry of the primary and secondary calcination steps, and special ultramarines. (IR-3)

cf: 38.1.5
Manufacturers:
American Cyanamid Company
Smith Chemical & Color Company
Standard Ultramarine & Color Company

### Iron Blue

**28.4.** (No abstracts)

Manufacturers:
American Cyanamid Company
Ansbacher-Siegle Corp.
E. I. duPont de Nemours & Co., Inc.
Imperial Paper & Color Corp.
Kentucky Color & Chemical Company
Mineral Pigments Corp.
Standard Ultramarine & Color Company

### Organic Violets

**28.5.** (No abstracts)

Manufacturers:
American Cyanamid Company
Ansbacher-Siegle Corp.
Holland Color & Chemical Company

# HIGH QUALITY PIGMENTS for *Paint*

## CARBON BLACKS
for every purpose

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| NEO-SPECTRA® MARK I<br>NEO-SPECTRA MARK II* | a superior quality black for outstanding jetness. |
| SUPER SPECTRA® | characterized by fast dispersion, high blackness and gloss. A vehicle-seeking black most used in high quality enamels and lacquers. |
| NEO-SPECTRA MARK III | a high color black which produces satin finishes with normal gloss in enamels and lacquers. |
| SUPERBA® | quality with economy. A vehicle-seeking pigment for medium high color finishes. |
| NO. 999 | best buy in blacks. More color, dollar for dollar — greater usefulness black for black. |
| EXCELSIOR®* | the special utility black. |
| NO. 140 | the all purpose black — standard for color — good hiding and dispersion — wide application. |
| RAVENS* | densed form for cleaner handling and less storage space—try the black that contributes better leveling qualities to finishes. |
| | good covering where low oil absorption is required. |

*Available in beaded form for ball mill dispersion.

## IRON OXIDES
Synthetic colors with light stability, high covering power, and acid and alkali stability.

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| MAPICO® YELLOWS<br>MAPICO REDS | 5 dependable colors, 4 with low oil absorption. |
| MAPICO CRIMSONS | a wide range of pigments providing bright mass tone and a multiplicity of pleasing tints. |
| MAPICO TANS | three rich shades which when cut with white produce many desirable tints. |
| MAPICO BROWNS | two entirely new iron oxide types on the reddish yellow side, with unusual ability to withstand high temperatures. |
| MAPICO BLACK | strong colors which alone produce richer brown paints than any combination of yellow, red and black iron oxides.<br>a low oil absorption black for tough finishes and tinting. |

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## CHAPTER 29

# BLACK PIGMENTS

### General

**29.1.** (No abstracts)

cf: 21.1.8
21.1.11
Manufacturers:
Ansbacher-Siegle Corp.
Godfrey L. Cabot, Inc.
Mineral Pigments Corp.
Smith Chemical & Color Company

### Carbon Black

**29.2.1.** Carbon blacks are reviewed in an article by the Technical Service Dept. of Binney & Smith Co. Today the paint & lacquer industries have available a greater variety of carbon blacks than ever before to fit the special demands of the formulator. (PVP-4)

**29.2.2.** The developments and refinements in the manufacture and utilization of carbon black over the past 25 years have led to a considerable increase in their use as pigments. In the first of a series of articles, Venuto reviews the manufacturing history, the types and the properties of carbon black. (PM-55)

**29.2.3.** Venuto, in the second of the series of articles on carbon black, considers the type of carbon black and the vehicle in which it is to be incorporated. They are important factors in the manufacture of paint. He also deals with the selection of the black for a particular use, the setting up of control standards and the storage and handling of these products. (PM-58)

**29.2.4.** Consolidated Carbon takes option on new carbon black process, plans construction of 10 plants. Commercial exploitation of the Lynn Furmatic method for making carbon black has moved a step further. The unproved process produces two types of commercial carbon black in the ink and rubber black ranges. (CEN-21)

**29.2.5.** After two years in development, a new carbon black process is ready to make its commercial debut. A novel spherical heating unit is the nub of the operation, called the Lynn Furmatic process, now somewhat modified from its original outline. Carbon black handicappers give the process due credit, but concede it only an outside chance of finishing in the money. (CW-21)

**29.2.6.** The combination of high-viscosity milling and specific dispersing agents yields the highest degree of true colloidal dispersion with the attendent brilliant gloss and blackness. This is one conclusion by Venuto, who in this third part of his article reviews the subject of milling procedure and makes further reference to solubility factors and to the influence of specific dispersing agents. (PM-63)

**29.2.7.** The problems encountered with or attributed to the use of carbon blacks as pigments are reviewed by Venuto in this the last part of his article. He also considers the final operations in the manufacture of the protective coating, and the tests which should be applied to ensure a satisfactory product. (PM-70)

**29.2.8.** The Acheson Dispersed Pigments Company has issued Technical Bulletin No. 100 on "The Function of Carbon Black in the Protection of Exposed Polyethylene."

**29.2.9.** Godfrey L. Cabot, Inc. has issued the second edition of 100-page book "Cabot Carbon Blacks Under the Electron Microscope." Electron micrographs and particle size data are presented for the various carbon blacks the company manufactures.

cf: 35.5.3
Manufacturers:
Binney & Smith Inc.
Godfrey L. Cabot, Inc.
Mineral Pigments Corp.
Sid Richardson Carbon Company
Smith Chemical & Color Company
United Carbon Company, Inc.
R. T. Vanderbilt Company

### Bone Black

**29.3.** (No abstracts)

cf: 38.1.5
Manufacturers:
Mineral Pigments Corp.
Smith Chemical & Color Company

### Lampblack

**29.4.** (No abstracts)

Manufacturers:
General Carbon Company
Mineral Pigments Corp.
Monsanto Chemical Company
Smith Chemical & Color Company
C. K. Williams & Company

## CHAPTER 30

# METALLIC FLAKES AND POWDERS

### General

**30.1.1.** A process for treating commercial, initially fatty-lubricated, lamellar copper-base bronze powder, for rendering said powder resistant to tarnish discoloration, comprising confining such a powder within an enclosure, maintaining in said enclosure a treating gaseous atmosphere, heating the powder at temperatures above 300° C. and below the sintering temperature of the particular powder being treated, continuing the heating until the initial fatty lubricant has been decomposed into a hard, transparent, invisible film covering the individual particles of the powder, and using a treating atmosphere having no decarburizing action on the particle's film, said atmosphere consisting of a gas chosen among the hydrocarbon gases, nitrogen, helium, carbon monoxide and also carbon dioxide in presence of organic matter vapors. (USP-78)

cf: 21.1.8
39.1.1
50.3.1
Manufacturers:
Magna Mfg., Co., Inc.
Metals Disintegrating Company, Inc.
United States Bronze Powder Works

**30.2.1.** Knoll reviews progress and recent developments in aluminum pigments. In the seventeen years since the Hall Process has been in commercial use, the list of aluminum pigments available to the coatings industry has increased from two or three to about 24. This is a result of the needs for specialized products each designed to accomplish a specific result. (PVP-7)

**30.2.2.** Frederick & Woosley discuss tests made to determine those characteristics which contribute to the optimum leafing of an asphalt aluminum roofing paint or coating.

The leafing power of a vehicle has a much greater range in the 11-15 second and the 15-20 second viscosities (#4 Ford Cup) than in the 21-25 seconds and 26-30 second viscosities. Its leafing power is affected by changes of specific gravity within the lower viscosities much greater than in the higher viscosities.

The use of a high solvency, high specific gravity thinner in reducing the asphalt base for an asphalt aluminum paint results in a better leafing product and a better paint film.

As with oleo-resinous varnishes, the higher the specific gravity and the lower the viscosity, combined with the proper evaporation rate, the better will be the leafing of an aluminum asphalt roof-coating vehicle. (PVP-45)

**30.2.3.** Rethwisch, et al, studied reflectivity of aluminum pigments and paint. Coarse grades show better reflectivity than fine grades. Total reflectivity values for coarse grades is not dependent on inclusion of specularly reflected light. The five grades show an average of 5-6% difference under same conditions. As pigments become finer, "whiteness" decreases and specular reflectivity increases. Specular reflectivity is a combination of fineness of film (or pigment) and degree of polish of the pigment. Whiteness or apparent reflectivity is a combination of roughness of film (or pigment) and lack of polish of the pigment. (POCR-9)

**30.2.4.** Babcock & Rethwisch discuss the classification of aluminum pigments; ie into leafing and non-leafing pigments. The leafing type consists primarily of an aluminum flake and may be in either paste or powder form. The non-leafing type may be either a flake or granular nature and may also be obtained in either paste or powder form.

The author discusses the selection of aluminum pigments, vehicles for aluminum pigments, application, and storage. (POCR-25)

**30.2.5.** The Aluminum Company of America has issued revised sheets listing characteristics for the various Alcoa Aluminum Pastes and Powders.

Manufacturers:
Aluminum Company of America
Reynolds Metals Company

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## CHAPTER 31

# LUMINOUS PIGMENTS

### General

**31.1.1.** Fluorescence is a rather unusual property of substances. Bowen attempts to explain the rarity of this property. This is due to two categories of factors, chemical reactions and internal conversion, which influence the emission of absorbed light energy. (JOCCA-31)

**31.1.2.** Varron discusses fluorescence and phosphorescence as well as less familiar aspects of luminescence, from a theoretical and practical standpoint. Included are emission spectra, physical aspects of fluorescence, polarization of fluorescence, quenching of fluorescence, constitution and fluorescence, and the applications. (IR-6)

cf: 23.3.1
Manufacturers:
Imperial Paper & Color Corp.
The New Jersey Zinc Company
Rhode Island Labs., Inc.

## CHAPTER 32

# METAL PROTECTIVE PIGMENTS

### General

**32.1.1.** Blowes, et al, present a continuation of their earlier paper on zinc dust as a protective pigment.

The behavior of air-drying zinc-rich paints on rusted surfaces in air is described and principles of formulation discussed. Suggestions are made for a formulation of optimal properties.

Experiments on the use of zinc-rich paints in comparison with some other anti-corrosive compositions in sea water are described. Mention is made of the use of zinc dust in stoving and heat-resisting finishes.

The use of zinc dust-zinc oxide oil paints as primers for steel and wood is discussed and the use of the colored types of these paints suggested.

Future developments with zinc dust pigments would seem to lie in the production of finer particle materials, either of leaf or spherical form. (JOCCA-39)

**32.1.2.** Killeffer describes the evaluating of molybdate pigments as corrosion inhibitors. Molybdates in solution are known to have corrosion inhibiting properties. (POCR-24)

cf: 39.2.2

### Chromates

**32.2.1.** Wakefield reviews and discusses the use of zinc yellow in primers for metal protection. The present concept of the primer as a most important component of a protective paint system involves coordination of such factors as pigmentation with inhibitive pigments (as zinc yellow), proper choice and balance of other pigments and vehicle to give maximum adhesion to the metal surface, a good foundation for following coats, a flexible, age resistant, low permeability film, and drying or baking properties to meet the scheduling of its applications. (PVP-11)

**32.2.2.** Schleicher presents part III of his paper on protection of steel. This part covers the subject of zinc chromate for primer coats. (PIM-30)

**32.2.3.** A composite lead chromate lead silicate pigment consisting essentially of PbO, $CrO_3$, and $SiO_2$ in physico-chemical combination, said PbO, $CrO_3$ and $SiO_2$ being analytically present so that there are from 2 to 10 mols of PbO for each mol of $CrO_3$ and from 0.75 to 7.5 mols of $SiO_2$ for each mol of PbO. (USP-84)

**32.2.4.** Kentucky Color & Chemical Co., Inc. has issued Customers Service Department Report on Kentucky's Strontium Chromate No. 2821, a straight chemical salt, valuable as a new rust-inhibitive pigment.

cf: 23.3.1
39.2.1

Manufacturers:
American Cyanamid Company
Ansbacher-Siegle Corp.
E. I. duPont de Nemours & Co., Inc.
Imperial Paper & Color Corp.
Kentucky Color & Chemical Company
Mineral Pigments Corp.
Smith Chemical & Color Company

### Red Lead

**32.3.1.** Vander Valk reviews and discusses the use of red lead for metal protection. Intensive research and comparative service testing by the Lead Industries Association has resulted in the development of many outstanding red lead base metal protective primers for a variety of applications. (PVP-10)

cf: 32.1.1
39.2.9

Manufacturers:
The Eagle-Picher Lead Company
National Lead Company

### Lead Cyanamide

**32.4.1.** One of the outstanding developments in pigments during the last few years has been lead cyanamide—and this pigment is being increasingly used in European anti-rust and marine paints. A brief historical background is given along with some formulation data.

Lead cyanamide is preferably used in linseed-oil primers, because it is here that its good properties are best utilized with regard to the possibility of lead soap formation. (PM-15)

### Zinc Dust

**32.5.** (No abstracts)

Manufacturers:
National Zinc Company, Inc.
The New Jersey Zinc Company

## CHAPTER 33

# DISPERSIONS

### General

**33.1.1.** Carr discusses dispersible pigment powders. The use of organic pigments in a water paste form as distinct from a dry powdered form is growing in many of the color-using industries. In the dyeing of paper, for instance, there is a steadily growing demand for shades which combine brightness with good light fastness. This demand can only be adequately met by the use of pigments, and pigments can only be applied to paper when in the paste form. The use of dry pigment powders generally results in dyeings in which large particles of undispersed pigments are present and in which the full color value of the pigment is not obtained. The ideal dispersible pigment powder for synthetic emulsion paints should possess the following properties:

a. should be dry, free-flowing, easy to transport, store and handle.
b. should wet out and disperse readily in water or emulsions without grinding and with ordinary stirring to give a fine suspension.
c. should contain a minimum of diluent or non-pigmentary material, and these should not impair the stability or performance of emulsion paints.
d. should not be much more expensive on a color strength-price basis than the corresponding dry pigment powders or pigment pastes.
e. should be non-dusting in character—that is, on handling, there should be no problem of flying color.

(PM-11)

**33.1.2.** A pigment paste comprising water, 100 parts of a pulverulent water-insoluble pigment and from 1 to 50 parts of a salt prepared by neutralizing a copolymer of styrene and a half-ester of maleic acid with a compound taken from the group consisting of ammonia, morpholine and alkyl amines which are volatile at temperatures

The same qualities that develop gloss on top of a film contribute to adhesion on the bottom. The reduction of pigment agglomerates, and thorough pigment wetting, give the binder its best chance to do its job.

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Pigment dispersions in nitrocellulose; ethyl cellulose; urea formaldehyde vinyl and alkyd resins; chlorinated rubber and other plastic binders

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below 100° C., the ester groups in said half-ester consisting of a mixture of methyl groups and secondary butyl groups, the ratio of methyl groups to secondary butyl groups varying from 11:89 to 8:52 mol percent. (USP-11)

**33.1.3.** A pigmented coating composition comprising an aqueous continual external phase, a dispersed pigment, a thickener, a cationic water soluble resin which is produced by reacting 1 mol of urea with from 2 to 3 mols of formaldehyde in the presence of at least one-third mol of a compound selected from the group consisting of pyridine, quinoline, water soluble aliphatic amines having at least one hydrogen attached to the amino nitrogen and hydroxy tertiary aliphatic amines, until a solution is obtained and then acidifying the mixture to a pH between 0.5 and 2.0 and immediately neutralizing to a pH of from 6.0 to 7.0; and an anionic polymeric material of the group consisting of polystyrene polyvinyl chloride and polyvinyl acetate, said anionic resin being present in an amount varying from 5% to 15% by weight based on the weight of the composition, said cationic resin being present in an amount sufficiently great to redisperse the anionic resin, the cationic resin of said composition being convertible to an insoluble state by heat. (USP-44)

**33.1.4.** The Acheson Colloids Company has issued 10-page Catalog No. 460 describing properties and uses of the various "dag" dispersions they manufacture.

**33.1.5.** The Sherwin-Williams Company has issued the second edition of their bulletin: Sherwin-Williams Colors for Latex Emulsion Paints. Dry pigments are discussed as well as dispersions of these colors in water.

cf: 21.1.3
29.2.1

Manufacturers:
Acheson Colloids Company
Acheson Dispersed Pigments Company
Aluminum Company of America
Ansbacher-Siegle Corp.
Holland Color & Chemical Company
Magna Manufacturing Company, Inc.
Metals Disintegrating Company, Inc.
Mineral Pigments Corp.
C. J. Osborn Company
Pennsylvania Color & Chemical Company
R-H-B Dispersions
Reynolds Metals Company
The Sherwin-Williams Company
Standard Ultramarine & Color Company
Vansul & Company

### Pearl Essence

**33.5.** (No abstracts)

Manufacturer:
National Lead Company

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- n-Propyl Acetate
- n-Butyl Acetate
- Isobutanol
- n-Butanol
- Celanese Solvent 203
- Celanese Solvent 601
- Celanese Solvent 901-H
- Methanol

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# SOLVENTS

## CHAPTER 34

# SOLVENTS

### General

**34.1.1.** Kunin states the behavior of ion exchange resins in nonaqueous systems is closely related to the nature of hydrocarbon chains present in the resin and to the porosity or the degree of cross linking. Ion exchange occurs to a greater extent, or more rapidly, in polar solvents than in nonpolar solvents. (IEC-23)

**34.1.2.** Ham reviews solvents for polyacrylonitrile. Solvents studied included amide-type solvents and nitro derivatives among others. (IEC-40)

**34.1.3.** Croswell discusses safety and dangers connected with solvents. Approximate maximum concentration and ventilation rate design data are given for approximately 30 common solvents. (IEC-47)

**34.1.4.** Johnson & Francis have obtained the phase diagrams and selectivity diagrams for the system benzene-heptane-diethylene glycol at temperatures varying from 25° to 175° C. The effect of water on this system also has been examined. (IEC-76)

**34.1.5.** Organic solvents are frequently used to suppress the solubility of slightly soluble salts. The selection of the organic solvent and its most effective concentration usually has been determined by trial and error methods. In .this paper, Jentoft & Robinson present an objective method, based upon mathematical derivation and involving graphical analysis of solubility data. This method should be of interest in all cases involving reduction of solubility through the use of organic solvents, whether in a method of analysis or in an industrial process. (AC-15)

**34.1.6.** The Carbide & Carbon Chemicals Company has issued the 1955 Edition (24-page) of Physical Properties—Synthetic Organic Chemicals.

**34.1.7.** The Carbide & Carbon Chemicals Company has issued a 6-page chart—Solvent Selector for Coating Formulations.

cf: 5.4.1
16.1.7
38.1.1
50.3.3

### Aliphatic Hydrocarbons

**34.2.1.** Wilson, et al, studied the solvency characteristics of low odor type thinners. Conclusions drawn are as follows.

With resins of 24% phthalic anhydride content, eastern and western type thinners yield solutions of approximately equal viscosity. The low odor and odorless thinners give solutions of higher viscosity, but at concentrations normally employed, i.e., 40%, probably have little effect on the resulting viscosity of a finished product.

With resins of 30% or more phthalic anhydride, the lower viscosity resulting from the greater solvent power of western type thinner is very evident at resin concentrations of 55% or higher, becoming negligible as the solids are reduced to 40%. The low odor and odorless types yield considerably higher viscosities at all resin concentrations tested.

Thinners of the slow evaporating type yield solutions of higher viscosity than might be expected from their indicated solvent strength, the increase being more apparent at resin concentrations above 30%.

The stability of solutions of resins containing 30% or more phthalic anhydride in odorless type thinners is questionable at solid contents of 25% and lower. (OD-8)

**34.2.2.** Larson & Low describe the alkyd reduction technique. By this technique, a number of additives added to low solvency thinners reduce the viscosity of the resin-thinner blends to brushability consistency.

Successful practical application of the technique requires that these additives have no adverse effects on the properties of the paint either prior to use or after it has been applied and the film is dry.

Of various features important to film quality, the following qualitative observations can be made:

a. Non-penetrating quality is preserved
b. Brushability is improved
c. Water resistance is not impaired
d. The film is not softened
e. Adhesion is not adversely affected
f. Drying time is not affected in enamel compositions, time to achieve ultimate hardness may be increased slightly.

(OD-24)

**34.2.3.** The Golden Gate Club made a study of the solvency characteristics of low odor type thinners. Five thinners were studied with 5 resin types. (POCR-4)

**34.2.4.** Oil-based interior paints, already hurt and threatened even further by latex emulsions, look to odorless mineral spirits to help stabilize their markets. (CE-21)

**34.2.5.** The R. J. Brown Company has issued 54-page compilation of data sheets on Bronoco aliphatic and aromatic solvents. Included are data for 16 aromatics and 31 aliphatic solvents.

ETHYL ALCOHOL
2-AMINO-2-METHYL-1,3-PROPANEDIOL
BUTYL STEARATE
DIBUTYL PHTHALATE
METHANOL
BUTYL LACTATE
NITROPARAFFINS
AMMONIA
ETHYL ACETATE
AMYL ACETATE
BUTYL ACETATE
RIBOFLAVIN, USP
N[illegible] DERIVATIVES
BUTANOL
DIMETHYLAMINE
ACETONE
1-NITROPROPANE
2-NITROPROPANE
FORMALDEHYDE
NITROETHANE
ALKATERGE®
NITROMETHANE
HYDROXYLAMMONIUM SULFATE
PENTAERYTHRITOL
MONOMETHYLAMINE
TRIBUTYL PHOSPHATE
DIETHYL OXALATE
2-AMINO-2-METHYL-1-PROPANOL
TRIMETHYLAMINE
HYDROXYLAMMONIUM CHLORIDE
HYDROXYLAMMONIUM ACID SULFATE
BENZYLTRIMETHYLAMMONIUM CHLORIDE

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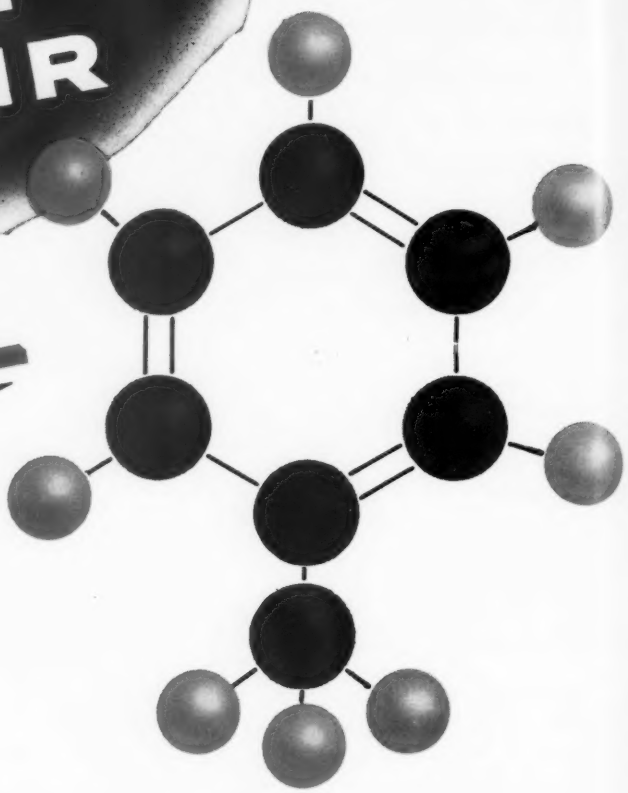

# TOLUOL

# XYLOL

and

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This new unit, which will provide a dependable supply of petro-chemicals for industry, will be in full production in March, 1955. Its operation marks another step forward in Sinclair's progress in the petro-chemical field.

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(Subsidiary of Sinclair Oil Corporation)
600 Fifth Avenue, New York 20, N. Y.

**34.2.6.** The Socony-Vacuum Oil Company, Inc. has issued a series describing Socony-Vacuum Solvents and their Uses. Included are Sovasols 1-6, 35,80, and 140.

**34.2.7.** Standard Oil of California introduced "Standard Odorless Thinner". This thinner has less odor than tap water, and far greater stability than many odorless thinners. Cost of thinner is 1½c higher than cost of conventional petroleum mineral spirits.

cf: 34.3.5
36.9.1
Manufacturers:
American Mineral Spirits Company
Anderson-Prichard Oil Company
The Atlantic Refining Company
The R. J. Brown Company
Central Solvents & Chemicals Company
Esso Standard Oil Company
Gulf Oil Corporation
Phillips Petroleum Company
Sinclair Chemicals, Inc.
Skelly Oil Company
Standard Oil Company of Calif.

**Aromatic Hydrocarbons**

**34.3.1.** Xylenes hit their importance-peak during World War II when large quantities were used for aviation gasoline and lacquer solvents. More and more separated xylenes will be available as petro producers vie (with expansions and new plants) for promising polyester fibers, new film and plasticizer markets. (CW-3)

**34.3.2.** Allied's Solvay Process Division producing pure orthodichlorobenzene. Technique used could work just as well on other nuclear chlorinated aromatics like toluenes, naphthalenes and thiophenes. (CW-8)

**34.3.3.** Lower defense requirements for benzene and possible business recession may make current production goals pass demand. There are prospects of surplus. (CEN-1)

**34.3.4.** Steady rise in production of benzene, toluene, xylene from petroleum continues; xylene reaches a new high. Petroleum-derived xylene hit a new production peak of 103 million gallons in 1953. The percentage of the three major aromatics that are petroleum-derived has risen steadily over the past five years. (CEN-19)

**34.3.5.** Billmeier & Rittershausen discuss the evaporation of petroleum thinners from protective coatings.

The rate of evaporation of all thinners, including essentially pure compounds as well as very narrow cuts, decreases considerably as the evaporation progresses when non-volatile materials are present.

The rate of the viscosity build-up of the protective coating rather than rate of evaporation of the solvent affects the initial set, wet edge time and brushability. The rate of viscosity build-up is a function of the viscosity thinning power as well as the inherent evaporation rate of the thinner.

A factor affecting the rate of evaporation of the thinner is the amount of thinner spread per unit of surface covered.

The initial rate of evaporation of a volatile thinner is not exclusively a function of the initial boiling point but is affected by the other components of the thinner. (OD-35)

**34.3.6.** The Carbide & Carbon


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Chemical Company has issued 4-page bulletin describing ethyl benzene.

**34.3.7.** The Eastern States Petroleum Company, Inc. has issued 20-page catalog describing Espesol 1,2,4,5,6,7, and benzol, all aromatic solvents.

cf: 34.2.5
Manufacturers:
American Cyanamid Company
American Mineral Spirits Company
Anderson-Prichard Oil Corp.
Barrett Division
The R. J. Brown Company
Central Solvents & Chemicals Company
Eastern States Chemical Corp.
Esso Standard Oil Company
Koppers Company, Inc.
Neville Chemical Company
Oronite Chemical Company
Pan American Chemicals
Penn. Ind. Chem. Corp.
Skelly Oil Company
Standard Oil Company of Calif.
Sun Oil Company
Velsicol Corp.

### Oxygen-Containing

**34.4.1.** Carlson et al discuss the separation of oxygenated organic compounds by water extractive distillation. The differences in relative volatility under water extractive distillation conditions allows complete separations, according to class, in one operation. Thus alcohols can be separated from ketones, aldehydes, esters, ethers, and hydrocarbons. Separations within a class can also be accomplished. For example isopropyl alcohol can be separated from ethyl alcohol. In all separations within a class, the higher molecular weight compound is rendered the more volatile. (IEC-36)

**34.4.2.** Acetone makers, plagued by current declines in cellulose acetate rayon output, lacquer sales, exports, face still another headache—keener competition from more acetone via newer phenol-from-cumene route. But welcome relief may lie in new solvent and other outlets such as intermediates. (CW-18)

**34.4.3.** Jones & McCants present ternary solubility data for systems:

1-butanol-methyl 1-butyl ketone-water; 1-butyraldehyde-ethyl acetate-water; and 1-hexane-methyl ethyl ketone-water. (IEC-83)

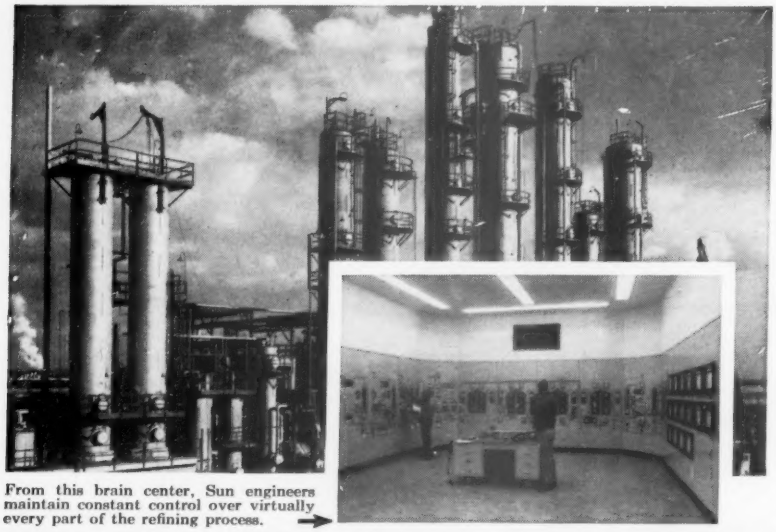
**34.4.4.** Brey presents analysis data for the ternary system: isopropyl alcohol-ispropyl ether-water. Numerical results are presented for mixtures at 5% composition intervals throughout the region of miscibility, and, where possible, these are compared with data from the literature. (AC-11)

**34.4.5.** Key to a way to rid isopropyl alcohol of the undesirable odor which often degrades the product is a high-pressure distillation to get top-purity propylene. (CE-10)

**34.4.6.** '54 outlook for alcohol & solvents—most competitive year in over a decade. Price reductions seem inevitable. Over the years, alcohols & solvents have reached their saturation point. With the exception of the growth factor, overall demand will not vary more than 10 percent either way. In two or three years, production curtailment will be necessary to avoid complete price demoralization. Balance between supply & demand should return with the growth of the country and its technological developments. (CE-13)

**34.4.7.** The American Monomer Corp. has issued Bulletin M-13 describing Methac Solvent, composed of a blend of methyl acetate and methanol.

**34.4.8.** The Wyandotte Chemical Corporation has issued 73 page book describing properties

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and uses of glycols and related products.

**34.4.9.** The Commercial Solvents Corp. has issued Technical Data Sheet No. 21 describing Ethyl Alcohol, pure-denatured-proprietory solvents.

**34.4.10.** Ethyl Acetate-new technical data sheet describing properties and uses, by Commercial Solvents Corp., 260 Madison Ave., New York 16, N. Y.

Manufacturers:
American Monomer Corp.
Baird Chemical Corp.
Carbide & Carbon Chemicals Company
Celanese Corp. of America
Commercial Solvents Corp.
The Dow Chemical Company
Eastman Chemical Products, Inc.
Enjay Company, Inc.
General Aniline & Film Corp.
Monsanto Chemical Company
The Quaker Oats Company
Sharples Chemicals, Inc.
Shell Chemical Corp.
Wyandotte Chemicals Corp.

### Halogen-Containing

**34.5.** (No abstracts)

Manufacturers:
Diamond Alkali Company
The Dow Chemical Company
E. I. duPont de Nemours & Co., Inc.
Kolker Chemical Works, Inc.
John B. Moore Corp.
Solvay Process Division

### Nitrogen-Containing

**34.6.1.** The Commercial Solvents Corporation has issued Technical Data Sheet No. 23 describing the nitroparaffins—nitromethane, nitroethane, 1-nitropropane, and 2-nitropropane.

**34.6.2.** E. I. du Pont de Nemours & Co. (Inc.) has issued 12-page technical bulletin describing properties and uses of nitrocyclohexane, on excellent solvent for a wide variety of substances.

Manufacturers:
Carbide & Carbon Chemicals Company
Commercial Solvents Corp.

### Terpene

**34.7.1.** Hawkins & Armstrong present equations to express the vapor pressure-temperature relations for $\alpha$-pinene and $\beta$-pinene between 15° and their normal boiling points and these relations are recorded The normal boiling points were found to be $155.9 \pm 0.1°$ for $\alpha$-pinene and $166.0 \pm 0.1°$ for $\beta$-pinene. (JACS-65)

cf: 14.1.4
14.1.6

Manufacturers:
American Turpentine Farmers Assn.
Arizona Chemical Company
Godfrey L. Cabot, Inc.
Central Solvents & Chemicals Company
Hercules Powder Company
Newport Industries, Inc.

# OILS AND FATTY ACIDS

## CHAPTER 35

# OILS AND FATTY ACIDS

### General

**35.1.1.** The solvent segregation of oils is discussed by LeRiche and Stubbs with particular reference to the use of liquid propane in the "Solexol" process. The mechanical, physical and technical properties of drying oils so produced are detailed, and oils having improved drying, color retention and uniformity of properties produced by segregation of sunflower seed oil and fish oils are described. The segregation of soybean, tobacco seed and dehydrated castor oils are briefly discussed. (JOCCA-17)

**35.1.2.** Chirgwin proposes that on the basis of Bailey's equation for deodorization, there is an optimum sparging rate, characteristic of each individual system, for steam distillation and its specialized forms, such as deodorization and stripping. It is suggested that the principles involved are applicable to continuous or batch systems of any size.

A simple method of determining this optimum rate is described and illustrated with data from a commercial batch deodorizer.

It is proposed that, under optimum conditions:

a. the ration of absolute pressure (P) to the blowing steam rate (R) is at a minimum;
b. total distillation is at a maximum;
c. the linear velocity of the vapor is at a maximum;
d. entrainment is disproportionately high.

It is recognized that this technically optimum blowing steam rate may not coincide with the most economical conditions of operation, depending on the characteristics of the system. (JAOCS-5)

**35.1.3.** Farooq & Siddique studied the fixed oil from the seeds of *Leucaena glauca*, Benth. (N.O. Leguminosae) for its component acids. The fatty acid composition, as determined by the ester-fractination analysis was found to be

| | |
|---|---|
| Palmitic | 12.74 |
| Stearic | 5.01 |
| Behenic | 3.64 |
| Lignocerie | 0.67 |
| Oleic | 23.63 |
| Linoleic | 54.31 |

(JAOCS-11)

**35.1.4.** Narayan & Kulkarni present nomographs for calculating the fatty acid composition of oils and fats from iodine values and either extinction coefficients or thiocyanogen values.

Very few alignment charts are available which can be used for routine calculations in fat analysis and processing. Three alignment charts are presented for determining the fatty acid mixture consisting variously of linolenic, linoleic, oleic, and saturated fatty acids or glycerides, incorporating for accuracy, data based on ultra-violet extinction coefficients. In two of the charts, triangular diagrams have been used to give directly the fatty acid composition. (JAOCS-19)

**35.1.5.** Oilar reviews several rare and uncatalogued oils of Ecuador. The oils discussed are all of vegetable origin. Also mentioned briefly are some oils from Columbia, Mexico, and Barbados, B.W.I. (JAOCS-20)

**35.1.6.** Piskur presents part one of the annual review of literature on fats, oils, and soaps reported by the Literature Review Committee. Groups covered in this first part include Introduction, Production Processes, Fatty Products (Except Detergents), and Deterioration of Fats and Oils. (JAOCS-23)

**35.1.7.** Piskur presents part two of the annual review of literature on fats, oils, and soaps reported by the Literature Review Committee. Groups covered in this second part include physiology and biochemistry, characteristics and composition, and detergents. Also included is a table "Characteristics of Fats and Oils" listing approximately 40 fats and oils, and a table "Composition of the Fatty Acids" listing approximately 30 fatty acids. (JAOCS-27)

**35.1.8.** Candlenut oil can be used, at least to a substantial extent, as a replacement for linseed in paints and after heat treatment, in varnishes and linoleum manufacture. The oil has been utilized commercially in Australia as a satisfactory alternative to linseed oil. (PM-48)

**35.1.9.** Prane discusses the use of safflower oil in paint vehicles. This oil has been known and cultivated for many years throughout parts of the world; however its use as a constituent for processed oils, varnishes, alkyds, and industrial coatings is rather recent. Safflower oil contains no conjugated fatty acids, has a high percentage of linoleic acid and low linolenic acid, saturated fatty acid and saturated plus oleic content. (OD-38)

**35.1.10.** Recent work at the Paint Research Station and the University of Liverpool has indicated that conophor oil may be successfully substituted for linseed oil in the manufacture of paints and varnishes. Bray reviews the progress in experimental

cult vation of the vine and the results of the examination of the oil roduced. (PM-61)

35.1.11. Gupta, et al, discuss the component acids of Kamala oil which shows promise as a substitute for tung oil. It contains about 60% of kamlolenic acid as the only major component with minor proportions of common linoleic, oleic, and saturated acids and probably some conjugated dienoid acid. The saturated components consist mostly of myristic and palmitic acids. (JAOCS-28)

35.1.12. Buerki & Holt have designed a continuous liquid-liquid extractor and present procedures devised for the determination of total fatty acids, oxidized acids and unsaponifiable matter. These procedures give results that are in agreement with the present A.O.C.S. Methods.

Advantages of this new method are:

1. simple in design, easy to operate & clean
2. operation is automatic
3. extractions are made rapidly with out troublesome emulsions
4. greater accuracy is possible
5. the enclosed system minimizes health and fire hazards inherent in the present A.O.C.S. Methods.

(JAOCS-31)

35.1.13. Prane discusses the use of safflower oil in paint vehicles. Properties and uses are discussed. (POCR-18)

35.1.14. Singer presents part I of Chapter VIII on oils in Fundamentals of Paint, Varnish, and Lacquer Technology. The author discusses segregation or fractionation, styrenation, maleanation, color and color retention, cyclopentadiene addition, copolymerization, catalyzed oils, sulphurized oils, conjugated oils, and sorbic acid oils. (APJ-11)

35.1.15. Brushwell presents part I of "Polymerization of Drying Oils by Heat". This first part includes:

I. Polymerization of Simple Molecules
   A. 1,4—Pentadiene
   B. Sorbic Ester
   C. Alpha—Pinine
   D. Hexatriene
   E. Methylcrotonate
II. Polymeration of Linoleates
   A. Dimer formation
   B. Rate studies

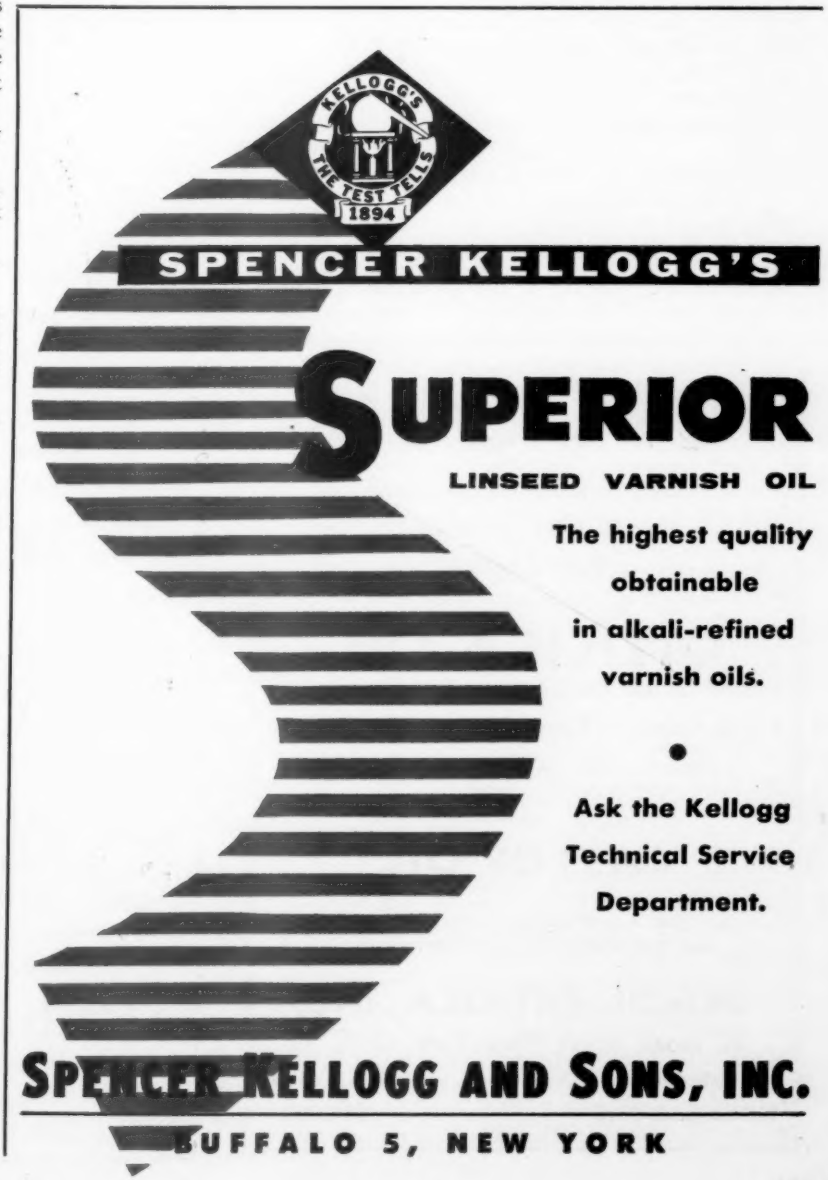
(APJ-13)

35.1.16. Brushwell presents Part II of "Polymerization of Drying Oils by Heat". Included are polymerization of eleostearates-monocylic dimer formation and bicylic dimer formation and cylic monomer formation, polymerization of linolenates, polymerization rates, and practical applications of thermal polymerization. (AFJ-14)

35.1.17. Singer presents part II of Chapter VIII on Oils in Fundamentals of Paint, Varnish, and Lacquer Technology. The author discusses tall oil and its treatment, a number of resins, and driers. (APJ-15)

35.1.18. Prane discusses the use of safflower oil in paint vehicles. Inherent in its composition are the following properties:

1. Uniformity of polymerization and polymer size
2. Good dry
3. Good color, color retention and freedom from yellowing
4. Decreased flexibility—due to

low content of saturated, plastizing acids.

Alkyds prepared from safflower oil exhibit:

1. Excellent through dry
2. Good gloss and gloss retention
3. Very good color and color retention
4. Improved compatibility with other film formers
5. Improved compatibility with low KB thinners—particularly odorless mineral spirits. (APJ-31)

**35.1.19.** Prane discusses the use of safflower oil in paint vehicles. Safflower oil possesses the following points:

1. high percentage of linoleic acid
2. low linolenic acid content
3. low saturated fatty acid content
4. low saturated and oleic content
5. contains no conjugated fatty acids. (PIM-11)

**35.1.20.** The Archer-Daniels-Midland Company has issued 24-page booklet listing specifications and uses of ADM oils, fatty acids, specialties, & chemical products.

cf: 13.1.4
18.1.6
36.2.6
38.1.11
50.1.1
50.3.8
50.7.1
50.9.1

Manufacturers:
Armour Chemical Division
Brown-Allen Chemicals, Inc.
El Dorado Oil Works
National Lead Company
Pacific Vegetable Oil Corp.
Spencer Kellogg & Sons, Inc.

### Linseed Oil

**35.2.1.** Fractionation techniques evolved to study the basic mechanism of thermal polymerization of drying oils can be applied to the technological evaluation of stand oils produced under different conditions. Walker, Mackay and Taylor describe two types of molecular distillation apparatus (a) a falling-film still, (b) a centrifugal cyclic still and illustrate their use in fractionating stand oils or methyl esters. Two versions of a novel liquid-liquid extractor are also shown, viz., a small-scale (100g) apparatus and a large-scale (1,000g) apparatus. The paper chromatography method used by Kaufmann in the examination of stand oils is critically reviewed. A series of stand oils of increasing viscosity have been fractionated by the above methods, and have been examined analytically and technologically. An air-blown stand oil (Bis oil) has been examined and compared with an uncatalyzed oil of similar viscosity. The importance of this work when applied to the manufacture of print paints for the linoleum industry is indicated. (JOCCA-12)

**35.2.2.** Cargill's new electronically controlled solvent extraction plant for linseed oil is now in full production in Minneapolis, Minn. The use of the Belgian DeSmet solvent process and equipment results in better refined special oils with less color. (CEN-12)

**35.2.3.** Paschke & Wheeler studied the inter- and intramolecular polymerization of heat-bodied linseed oil. Linseed oil was polymerized at 300° for 1.5, 3, and 6 hours. The polymeric glycerides were separated from the monomeric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glycerides, and the derived methyl esters of each fraction were analyzed for monomer, dimer, and trimer.

The monomeric glycerides showed very little intradimerization, ranging from 1.3 to 6% of the acid groups, or 3 to 4% of the total polymeric acid groups in the whole oil.

The polymeric glycerides showed appreciable introdimerization, from 10 to 20% of their total polymeric acid groups.

There was no evidence of a shift from intra- to interdimerization being the major cause of the sudden increase in viscosity in the later stages of thermal polymerization. (JAOCS-25)

**35.2.4.** Slansky describes some experiments dealing with the alkali isomerization of linseed oil fatty acids, using glycerine as solvent, and leading to conjugation of about 50% of the total fatty acids. It was possible to separate a fraction from the isomerized linseed oil fatty acids, the triglyceride of which had a gelation time similar to that of tung oil. Despite the short gelation time the film-forming properties of this oil, with the exception of drying rate, were not very different from those of untreated linseed oil. It was found that a considerable amount of stearic acid was formed during the reaction of isomerization. This may explain the absence of parallelism between the gelation time and film-forming properties of alkali isomerized linseed oil. (PM-37)

**35.2.5.** Sims studied the dilution polymerization of linseed oil. An inert diluent, molecularly distilled mineral oil, when present in 90% concentration, permitted, in linseed oil, the polymerization of acyl groups in the absence of interglyceride reaction. Comparison of the data for the polymerization of linseed oil in 10,20, and 100% concentrations showed a marked concentration dependence for the following: polymerization of acyl groups and glyceride molecules; change in specific refraction and the ratio of percentages by weight polymeric acyl groups to polymeric glyceride molecules. (JAOCS-30)

**35.2.6.** Cargill, Inc., processors and refiners of vegetable oils, have announced their new solvent extraction plant for linseed oil is now in full production in Minneapolis. This electronically controlled plant is the first linseed plant of its kind in America. (APJ-37)

**35.2.7.** Linseed Oil: Archer-Daniels-Midland Co. has started production at its new $2-million linseed-oil plant at Buffalo, N. Y. reported to be one of the largest Buffalo waterfront developments in recent years.

cf: 35.1.1
38.1.1
38.1.11
39.1.3
50.1.1
50.1.10

Manufacturers:
Archer-Daniels-Midland Company
Brown-Allen Chemicals, Inc.
Cargill, Inc.
National Lead Company
Pacific Vegetable Oil Corp.
Spencer Kellogg & Sons, Inc.

### Castor Oils

**35.3.1.** Patton & Lindlaw discuss the use of tall oil-dehydrated castor oil blends to prepare inexpensive quality varnishes. Refined tall oil and a Z3 viscosity bodied dehydrated castor oil form the key varnish components. The paper discusses proper techniques for preparing these economical quality varnishes and reports on their performance characteristics. (PVP-20)

**35.3.2.** Bolley studied the optical activity of castor oil and its derivatives. Pure methyl ricinoleate and methyl acetyl ricinoleate were prepared. The mixed methyl esters and acetylated methyl esters of castor oil were also prepared. By the determination of specific rotation of the pure and technical esters, the percentage of ricinoleate fraction can be deduced. This was calculated to be 93% and 90%, respectively. The esters of castor oil were calculated to contain 91.6% ricinoleate from the chemical hydroxyl value. This was about the average of the two values obtained optically and is believed close to the actual value. A number of castor oils were analyzed by both optical and chemical methods and found to be of nearly constant ricinoleic content. Dehydrated castor oil was found to have a comparative high specific rotation. This was believed due to its estolide content formed during dehydration. (JAOCS-1)

**35.3.3.** Slansky discusses various methods for the dehydration of castor oil both in the laboratory and on a commercial scale. Much of the information is given in tabular form to facilitate reference. Seven tables are included covering properties of castor oils dehydrated using various catalysts, results of neutralizing experiments, preparation of large batches of DCO, influence of various drier combinations, drying properties of various oil combinations, drying time and water resistance of various varnishes, and water absorption of various varnishes. (PM-30)

**35.3.4.** Kissal, et al, studied analytical control of processes for dehydrating castor oil. As a result some spectroscopic methods were developed to supplement those chemical methods of analysis which experience has shown will give the most consistent results.

The new methods employing infrared and ultraviolet spectroscopy are compared. It was found that the degree of dimerization could be estimated from ultraviolet data. (OD-25)

**35.3.5.** Penoyer, et al, discuss the synthesis of drying oils by thermal splitting of secondary fatty acid esters of castor oil. The hydroxyl attached to the 12th carbon of ricinoleic acid in castor oil has the characteristics of a secondary alcohol function, and it can form esters with fatty acids. The formation and decomposition of the secondary esters in a process where castor oil is dehydrated in the presence of free fatty acids is the subject of this research. (JAOCS-32)

cf: 35.1.1
38.1.11

Manufacturer:
Spencer Kellogg & Sons, Inc.

### Tung Oils

**35.4.1.** Plank, et al, have developed a new modification of the Rosenmund-Kuhnhenn method for determining the total ethylenic unsaturation of tung oil and eleostearic acids. With tung oils this method results in iodine values which are in agreement with those obtained by quantitative catalytic hydrogenation and, in the case of $\alpha$- and $\beta$-eleostearic acids, with the theoretical value. Good agree-

ment was found with hydrogen-iodine values of various partially hydrogenated tung oils. Mercuric acetate is added to the oil prior to the addition of the R-K reagent in contrast to the Benham-Klee modification where the reagent is added first. Light was found to affect the results obtained. (JAOCS-3)

**35.4.2.** Planck presents a review of tung oil for 1951-1952. 205 references are cited. (JAOCS-6)

**35.4.3.** Planck, et al, have applied recently developed spectrophotometric methods for the determination of linoleic and conjugated dienoic acids in the presence of large amounts of eleostearic acid to the determination of the fatty acid composition of a series of progressively hydrogenated tung oils. Utilizing hydrogen-iodine values and independently obtained values for saturated fatty acids, it has become possible to calculate concentrations of isolinoleic and of monoethenoic acids. Use of these methods gives a more complete and accurate knowledge of the fatty acid composition of a partially hydrogenated tung oil, or mixture of other oils containing the same types of components, than has been obtainable by previously published spectrophotometric methods. They are also much less time-consuming than solvent fractionation methods.

Data are presented which show the changes in fatty acid composition occurring during the hydrogenation of a domestic tung oil from an iodine value of 231 to 78. (JAOCS-8)

**35.4.4.** Holmes & Pack investigated the storage of tung oil in clean, well-filled gallon containers for more than three years and at the end of that time the oil still met A.S.T.M. specifications.

Storage locale (indoor, outdoor, sheltered, or unsheltered containers) and the exterior coating on the containers in exposed locations were found to be of less importance than protection of the stored oil from atmospheric oxygen.

The most pronounced effect of prolonged storage on tung oil is a shortening of the heat test (gel time at 282° C.)

Uncontaminated tung oil does not spontaneously isomerize during storage. (JAOCS-16)

**35.4.5.** McKinney & Holmes present a rapid petroleum naphtha method for determining the oil content of tung products. The method was applied to samples of tung fruit, press cake, and filter cake. Portions of these samples were also analyzed for oil content, using the Official Methods of the American Oil Chemists' Society for Tung Fruit and Meal. This new rapid method gave results which were in good agreement with those obtained with the 4-hr. extraction with petroleum ether required in A.O.C.S. Official Method Ad 3-52. (JAOCS-22)

Manufacturers:
Brown-Allen Chemicals, Inc.
Pacific Vegetable Oil Corp.

### Soybean Oil

**35.5.1.** Arnold and P'Pool have secured data on the countercurrent extraction of soybean flakes by trichloroethylene in a laboratory extraction pilot plant having a capacity of about 10 lbs. per hour. Feed rates and extraction times departed only slightly from a straight line relationship with the speed of the chain used to move the flakes through the extractor. Over the ranges studied, changes in solvent-feed ratios had a much greater effect than the extraction time on the amount of oil extracted. Over a practical range of temperatures with the solvent-feed ratio constant, the residual oil content of the meal showed a straight line relationship with the temperature. (JAOCS-9)

**35.5.2.** Dunning & Terstage describe the prepressing of soybeans prior to solvent extraction. Soybeans readily lend themselves to the pre-pressing operation. The pre-pressed, conditioned, and flaked soybean cakes however even at less than 10% oil content do not show a higher rate of extraction over standard soybean flakes. (JAOCS-13)

**35.5.3.** Carrick & Trease investigated the cohesive strengths of alkali refined soybean oil films to determine the effect of the addition of pigments. Pigments used were ppt. $CaCO_3$, anatase $TiO_2$ and carbon black with 3 particle size ranges for each. The results of these tests have shown that pigments exert a definite reinforcement effect on the cohesive strength of a paint film. (PO[illegible] R-27)

cf: 35.1.1
Manufacturers:
Archer-Daniels-Midland Company
Brown-Allen Chemicals, Inc.
Cargill, Inc.
Pacific Vegetable Oil Corp.
Spencer Kellogg & Sons, Inc.

### Oticica Oil

**35.6** (No Abstracts)

Manufacturers:
Pacific Vegetable Oil Corp.

### Fish Oil

**35.7.1.** The Archer-Daniels-Midland Company has issued 13-page Technical Bulletin 904A describing ADM Sperm Oil products; characteristics, chemical and physical properties, composition, applications and suggested uses for sperm oils, fatty acids, and sperm-aceti wax.

cf: 35.1.1
35.10.3
Manufacturers:
Archer-Daniels-Midland Company
Cargill, Inc.
Pacific Vegetable Oil Corp.

### Tall Oil

**35.8.1.** Karabinos & Ballum continue their tall oil studies. A method for decolorizing tall oil-ethylene oxide condensates (polyethenoxy tallates) by use of ozone or hydrogen peroxide is presented. The chemistry of the possible reactions involving quinoid structures is discussed. (JAOCS-15)

**35.8.2.** Ferlin, et al, report on the bactericidal activity of polyethenoxy tallate ozonides. It was assumed that the fat-soluble, water-soluble ozonides were responsible for this germicidal activity. However it was found that decomposing the ozonides to their corresponding acids (e.g., by hydrogen peroxide in aqueous acetic acid) not only increased bactericidal activity but that the active principle could be separated from the residual polyethenoxy esters by steam distillation. It was determined that the active bactericidal principle was essentially pelargonic acid and that the activity varied with the pH of its solution. (JAOCS-17)

**35.8.3.** Karabinos & Ballun continuing their tall oil studies discuss the synthesis and comparative detergency of built polyethenoxy sitosterols. (JAOCS-18)

**35.8.4.** Twice-blessed, tall oil and its components have an abundant

source and a market waiting. Cheaper refining methods will build a better bridge between the two. (CF-19)

**35.8.5.** Brushwell discusses economics and chemistry of tall oil. Tall oil is now an accepted and important raw material for the paint industry. The history of tall oil, the statistics related to its production, the chemistry of this interesting product, and the refining and manufacturing techniques applied to it are described in detail. (APJ-69)

**35.8.6.** Brushwell presents part II in his series on tall oil and its functions in the paint industry. This part discusses the properties of commercial tall oil products. Typical properties of a polymerized tall oil and a solvent-extracted oil are presented. Included are the manufacture and refining of tall oil, fractionation of tall oil, chemical modifications of tall oil, analytical methods applied to tall oil, and the handling of tall oil. (APJ-74)

**35.8.7.** In a process for treating tall oil, the steps of fractionally distilling tall oil, withdrawing an overhead fraction consisting mainly of low-boiling unsaponifiable matter and palmitic acid, taking off a second fraction consisting mainly of oleic acid and linoleic acid and fractionally crystallizing the second fraction to obtain oleic acid in the solid phase. (USP-67)

**35.8.8.** The Tall Oil Association has issued Bulletin No. 13 presenting Part I of "Tall Oil for Resins".

**35.8.9.** The Tall Oil Association has issued Bulletin No. 14 presenting Part II of "Tall Oil for Resins".

cf: 14.1.2
35.1.1
35.1.17
35.3.1
36.5.6
38.1.11
39.2.8

Manufacturers:
Arizona Chemical Company
Newport Industries, Inc.
R. A. Steel Chemicals, Inc.
Union Bag & Paper Corp.

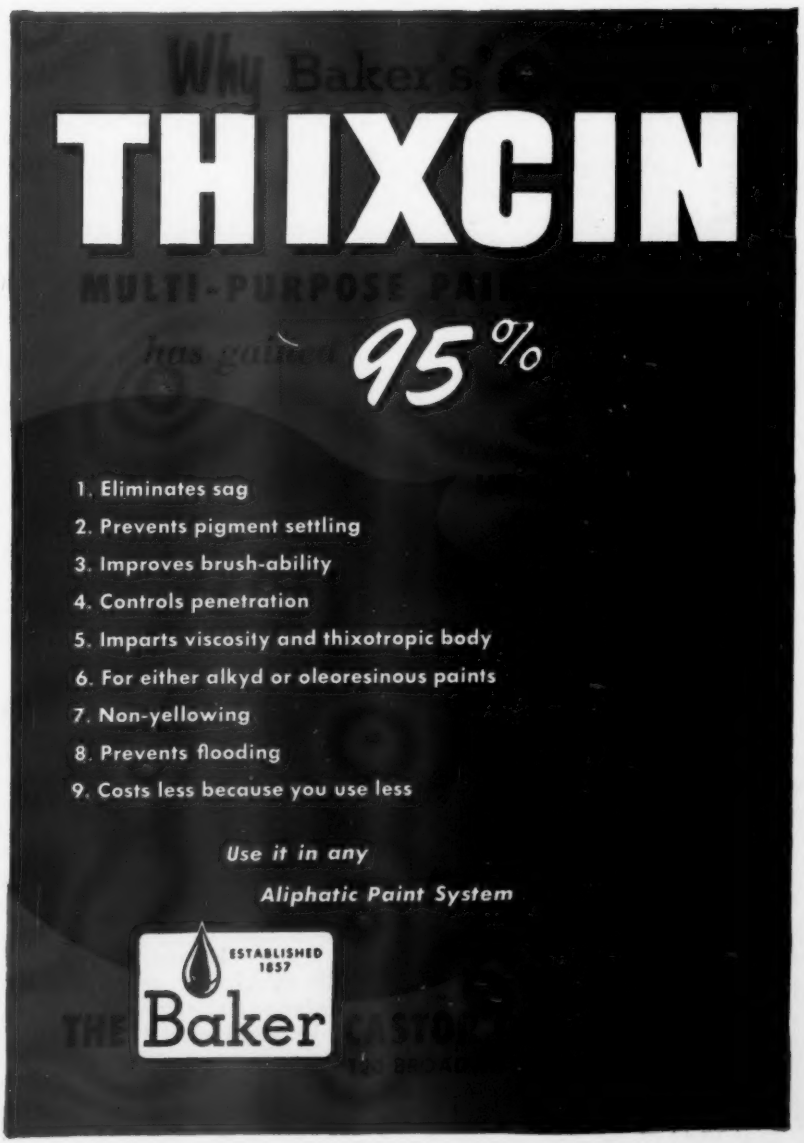
### Synthetic Drying Oils

**35.9.1.** Weiss describes the properties of modified oils obtained from saturated fatty acids. The process involves the addition of an organic 'catalyst" to solutions of saturated fatty acids. The solutions thicken, their acid values fall, and when spread in thin films the resulting oil is sensitive to oxygen and dries to give a protective film. (PM-22)

**35.9.2.** Gourley discusses pentaerythritol drying oils as paint media. The change from glycerol to pentaerythritol esters in fatty oils for paint media leads not only to faster polymerization and harder films but also to better outside durability, according to the results of experiments described in this article. The oil obtained by esterifying linseed oil fatty acids with pentaerythritol has been tested against linseed oil in orthodox oleoresinous white paints based on nine commercially available hard resins. (PM-43)

**35.9.3.** Terrill discusses improved drying oils. One phase of the many advances in coating chemistry and technology in recent years has been the development of various modified drying oils. Factors involved in this development have been

1. war-induced shortage of natural drying oils
2. over-all expanding market
3. need for better coatings
4. desirability for utilization and

development of domestic sources of drying oils, and for interchangeability among various oils

5. general advance of research and of applied chemistry. (PIM-3)

**35.9.4.** A process for improving the air-drying properties of a liquid co-polymer resulting from the co-polymerization of an aliphatic mono-isoolefin hydrocarbons and a conjugated diolefin hydrocarbon each containing not more than about 8 carbon atoms per molecule, in the presence of hydrogen fluoride catalyst at a temperature of from about—100° to about 0° C., whereby the copolymer contains organic fluorides, said process comprising separating said liquid co-polymer from the hydrogen fluoride catalyst and thereafter commingling therewith a polyhydric alcohol in the ratio of from about 1 to 1 to about 100 to 1 weight proportions of co-polymer to polyhydric alcohol, and subjecting the resultant mixture to reaction at a temperature of from about 50° to about 250°C. to effect substantial condensation of the hydroxyl groups of said alcohol with the organic fluorides in the co-polymer.

The process of claim 1 further characterized in that said co-polymer and polyhydric alcohol are reacted with a carboxylic acid. (USP-9)

**35.9.5.** A process for preparing a drying oil which comprises mixing a cyclopentadiene with an acylated linear copolymer of about 10 to 30% styrene and 90 to 70% isobutylene having a molecular weight between about 1,000 and 20,000 and containing about 0.2 to 1 mole of combined acyl groups per mole of aromatic styrene nuclei of the copolymer chain, about 0.5 to 1.2 moles of the cyclopentadiene being present in the reaction mixture per mole of combined acyl groups and maintaining the mixture at 10° to 50° C., in the presence of a metal alcoholate condensing agent until the cyclopentadiene and the carbonyl groups of the acylated copolymer are condensed with the elimination of water. (USP-26)

**35.9.6.** An enamel base comprising an oily sodium copolymer of 75 to 85 parts of butadiene-1,3, 25 to 15 parts of styrene and 0.05 to 0.5 part of maleic anhydride combined therewith, said copolymer having an intrinsic viscosity between about 0.15 and 0.30. (USP-32)

**35.9.7.** A process for producing a drying oil composition, which comprises admixing a polymer consisting essentially of an unsaturated, pre-dominantly open-chain liquid hydrocarbon polymer of an open chain conjugated diolefin, said polymer having a viscosity of from 20 to 150 poises at 77° F., with an unsaturated glyceride oil in the amount of 2 to 20 per cent by weight of said glyceride oil, and heating a resulting admixture at 550 to 600° F. for 2 to 6 hours. (USP-37)

**35.9.8.** A process for preparing a drying oil which comprises co-polymerizing a mixture of from 75 to 85% of butadiene and 25 to 15% of styrene in 200 to 300 parts of a hydrocarbon diluent per 100 parts of monomers and 20 to 30 parts of a member of the group consisting of aliphatic ethers of 4 to 8 carbon atoms and cyclic diethers of 4 to 8 carbon atoms, in the presence of 0.5 to 5 parts of finely divided sodium at a temperature between 40 and 85° C., continuing the polymerization until substantially 100% conversion is obtained where a product is obtained which has a viscosity somewhat less than that ultimately desired, killing and removing the catalyst and then heating the product in the absence of air at a temperature between 175 and 275°C. until a drying oil having the desired viscosity is obtained. (USP-102)

**35.9.9.** A process for improving a polymeric drying oil prepared by copolymerization of 75 to 85 parts of butadiene-1,3 and 25 to 15 parts of styrene in the presence of metallic sodium which comprises mixing said oil with 0.5 to 10% of a reagent selected from the group consisting of acrylic nitriles, alkyl acrylates, vinyl acetate, vinyl ketones, cinnamaldehyde, thioglycolic acid, alkylthioglycolates, and thiosalicyclic acid, and heating the mixture at a temperature between 50° and 250° C. (USP-150)

**35.9.10.** The Enjay Company, Inc. has issued Technical Bulletins No. 2 and No. 3 describing C-6 oil, a hydrocarbon drying oil, and the preparation of resins from C-6 oil.

Manufacturers:
Enjay Company, Inc.
McClosky Varnish Company
Pan American Chemicals
Reichhold Chemicals, Inc.
Fred'k A. Stresen-Reuter, Inc.

### Fatty Acids

**35.10.1.** Earhart reviews trends and factors affecting the use of fatty acids in alkyd resins. The major variables have been divided into the following categories—trends in the uses of alkyds, trends in the formulation of alkyds, economic trends, trends in the use of fatty acids, trends in fatty acids availability, and trends in specifications. (PVP-30)

**35.10.2.** Knight, et al, describe a new method for hydroxylating long-chain unsaturated compounds which involves addition of formic acid at its boiling point to the double bond followed by hydrolysis of the intermediate formate esters. The addition reaction proceeds slowly in absence of catalysts but strongly acidic substances, such as perchloric or sulfuric acids, speed up the addition tremendously.

Monohydroxystearic acids can be prepared in good yield by addition of 90-100% formic acid to the double bond of oleic or elaidic acids, methyl oleate, followed by hydrolysis.

Acetic acid in the presence of acidic catalysts also adds to the double bond at its boiling point, but yields are lower than with formic acid. (JAOCS-10)

**35.10.3.** Abu-Nasr, et al, studied the fractionation of highly unsaturated fatty acids by urea inclusion compounds. Urea segregation has been found to be a useful tool in concentration of highly unsaturated acids and esters. Fatty acids and esters derived from fish oils and methyl esters of hog adrenal fatty acids have been fractionated and the polyunsaturated acids have been enriched. The tendency for fatty acids and esters to combine with urea decreases with increasing unsaturation. Combination is favored by lowered temperature. (JAOCS-11)

**35.10.4.** Karabinos & Ferlin determined the bactericidal activity of certain fatty acids. Fatty

acids in the $C_8$ to $C_{12}$ range are bactericidal to a number of different organisms, and this activity is markedly enhanced with increasing acidity. Optimum bactericidal activity to *Staphylococcus aureus* was exhibited by undercylic acid. Since the activity is of the order as that of the quaternary ammonium germicides in alkaline solution, an explanation for both types of germicidal activity is presented in which the bacteria or some protein essential to the bacteria are considered to be "suffocated" by a "coating" of fatty groups in chemical combination with the protein. (JAOCS-26)

**35.10.5.** Earhart discusses trends and factors affecting fatty acid usage in alkyd resins. The major variables have been divided into the following categories:

1. Trends in the uses of alkyds
2. Trends in the formulation of alkyds
3. Economic trends affecting the use of fatty acids in alkyds
4. Trends in the use of fatty acids that may be affected by other chemicals for resins
5. Trends in fatty acids available for resin manufacture
6. Trends in specifications for fatty acids. (APJ-33)

**35.10.6.** The Archer-Daniels-Midland Company has issued 40-page booklet describing uses and properties of Hydrofol Products. These include sperm oils, hydrofol fatty acids, adol fatty alcohols, hydrofol glycerides from vegetable, animal, and marine oils and fats.

**35.10.7.** The Polychemicals Department of E. I. du Pont de Nemours & Co. (Inc.) has issued four technical data sheets describing properties and uses of Loral 5,7,20,22,24 and 28, a series of fatty alcohols.

**35.10.8.** Emery Industries, Inc. has issued 9-page Technical Bulletin No. 50-A describing properties, characteristics, solubility data, and applications of some new Emery modified solid acids.

**35.10.9.** Emery Industries, Inc. has issued Technical Bulletin #53 properties of Emfac 1202 Pelargonic acid, a fully saturated C-monobasic fatty acid, and its use in baking enamels.

cf: 16.1.2
16.1.3
35.1.4
35.1.20
50.1.4

Manufacturers:
Archer-Daniels-Midland Company
Arizona Chemical Company
Armour Chemical Division
El Dorado Oil Works
Emery Industries, Inc.
A. Gross & Company
Pacific Vegetable Oil Corp.
Spencer Kellogg & Sons, Inc.
Swift & Company

### Fatty Alcohols

**35.11.1.** The Archer-Daniels-Midland Company has issued 10-page Technical Bulletin 903A Describing properties and uses of ADM Fatty Alcohols—Adols and Unadols.

**35.11.2.** The Ethyl Corporation has issued 8-page Chemical Sales Bulletin describing Fatty Alcohols for Industry.

cf: 35.10.6
Manufacturers:
Archer-Daniels-Midland Company
E. I. duPont de Nemours & Co., Inc.
Ethyl Corporation
The Stephan Chemical Company

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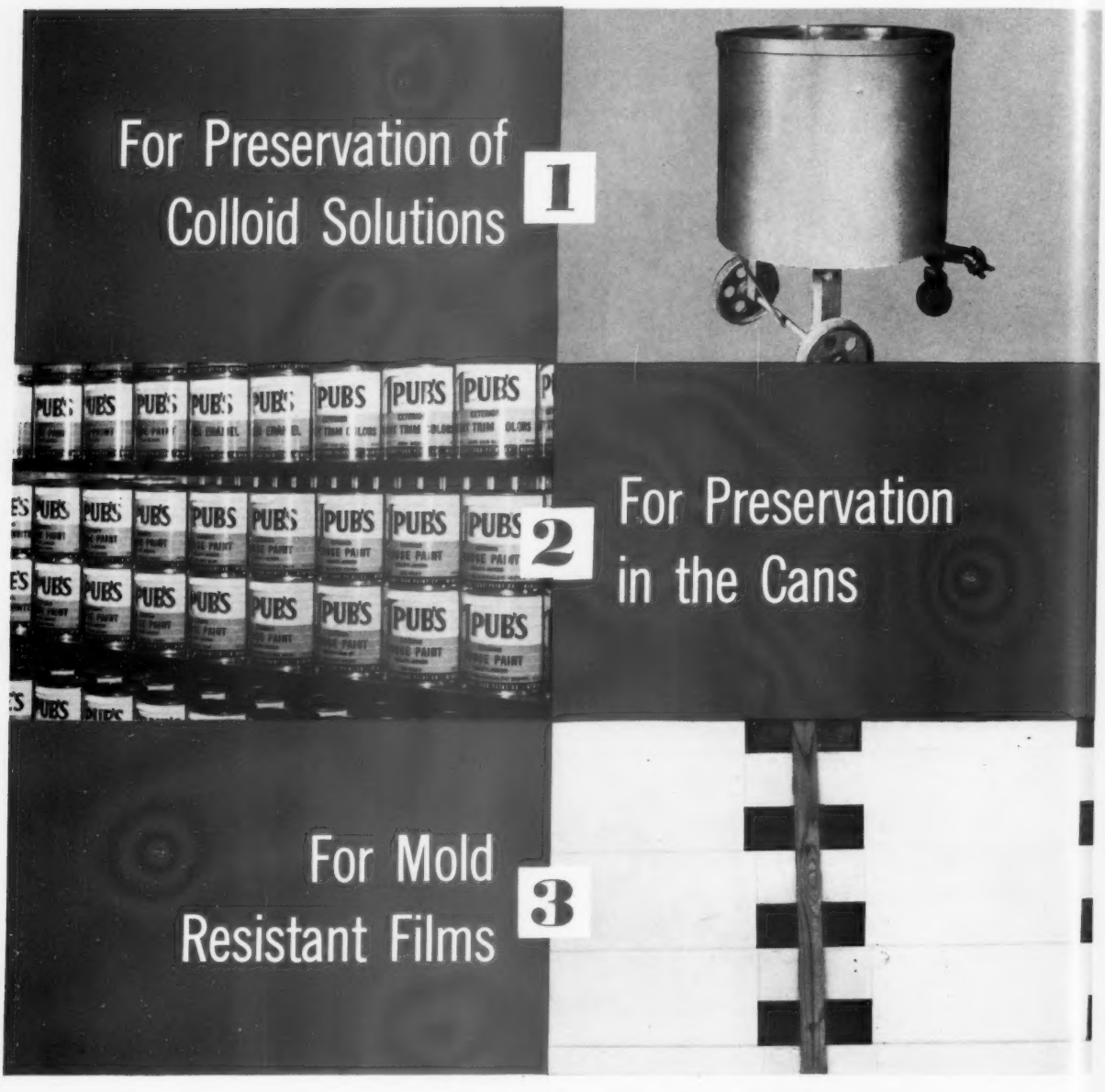


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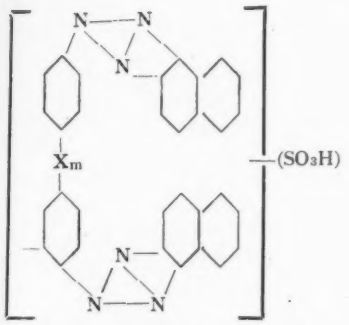
## CHAPTER 36

# MISCELLANEOUS RAW MATERIALS

### General

**36.1.1.** Brandt & Nunn discuss the use of ultraviolet light absorbers in clear furniture lacquers. Of the materials tested, two materials, both substituted benzophenones, proved to be effective absorbers of ultraviolet radiations without being destroyed by such radiations. Their use in furniture lacquers did not interfere with the normal bleaching effect that sunlight has on white oak and black walnut. (PVP-49)

**36.1.2.** A compound of the group consisting of acids of the general formula:




wherein X stands for a vinylene and *m* for a whole number form 0 to 1, and salts of such acids selected from the group consisting of the alkali metal, ammonium, alkaline earth and amine salts, said compounds being substantially colorless and possessing an excellent whitening effect.

White organic materials having incorporated therein an effective amount of a whitening agent as defined in claim 1. (USP-86)

**36.1.3.** The Advance Solvents & Chemical Corp. has issued a loose leaf binder containing a complete set of bulletins describing the Advance Driers and Paint Specailties, Paint Additives, Plasticizers, and Stabilizers.

### Driers

**36.2.1.** Mueller proposes a mechanism of drier action in drying oil oxidation and polymerization. Lundberg, et al, present a panel discussion of the proposed mechanism. (IEC-44)

**36.2.2.** Skoog & Focht developed a very simple and rapid procedure for the analysis of lead driers which does not require the preliminary isolation of the metallic ion from the organic substrate. Various lead naphthenates, octoates, linoresinates, linoleate and resinate were investigated. The naphthenates of several other metals were also investigated to determine whether this technique might not have wider application. These included iron, cobalt, manganese, copper, and zinc naphthenates. Only copper gave a satisfactory wave; further work on copper soaps is now in progress and results to be published subsequently. (AC-2)

**36.2.3.** Stearns discusses the use of 1,10-phenanthroline to promote the drying of paints. 1,10-phenathroline accelerates, in varying degree, the drying of all films which cure by polymerization, or by oxidative-polymerization. The drying rate is stabilized by the presence of 1,10-phenanthroline.

An optimum point can be found for each combination of drier metal and 1,10-phenanthroline where drying is most rapid; stabilization appears to be most assured at this optimum point. (OD-61)

**36.2.4.** Rinse discusses aluminum alkoxides as new components in the preparation of vehicles for paints. In the presence of humid air, aluminum alkoxides act as driers and permit the preparation of tall oil paints which dry in a matter of seconds on exposure to humid air. (PT-1)

**36.2.5.** Gregg discusses the use of zirconium metal as a drier catalyst. Zirconium acts as a drier product capable of synergism. Its utilization in combination with cobalt, manganese, calcium, is of great interest to the paint finish formulator. (PIM-14)

**36.2.6.** A process of treating a drying glyceride oil which comprises heating the oil to bodying temperature in the presence of .05 to 3% of a catalyst consisting essentially of 9-anthrone until a desired increase of viscosity is attained. (USP-96)

**36.2.7.** The Advance Solvents & Chemical Corp. has issued 66-page Handbook of Driers and Specialty Chemicals for the Paint, Varnish and Lacquer Industries.

**36.2.8.** The Harshaw Chemical Company has issued 2-page bulletin describing properties of Lo-Odor Octasol Driers—Harshaw 2-Ethylhexoates.

**36.2.9.** R. T. Vanderbilt Co., Inc. has issued 4-page bulletin describing the use of Activ-8 in a Tall Oil Alkyd Vehicle.

**36.2.10.** The Witco Chemical Company has issued Bulletins P-20 and P-21 describing Witco Odorless Cobalt and Lead Driers. Drying power of each is equivalent to the corresponding naphthenate.

**36.2.11.** The Witco Chemical Company has issued Bulletin 54-2 describing Witco Driers—Their Properties and Uses.

cf: 4.1.2
35.1.17
36.4.5

39.1.3
50.3.1

Manufacturers:
Advance Solvents & Chemical Corp.
The Harshaw Chemical Company
McClosky Varnish Company
Naftone, Inc.
Nuodex Products Company, Inc.
Fred'k A. Stresen-Reuter, Inc.
R. T. Vanderbilt Company, Inc.
Witco Chemical Company

**Fungicides**

**36.3.1.** Meier & Schmidt review the growth of fungi on paint films. Destruction of paint films is due not only to the action of moisture, heat, cold, sunrays and mechanical influences, but in a much higher degree to the growth of fungi.

The authors discuss the kinds of fungi, conditions of growth (food, temperature, moisture and light), behavior of vehicles, influence of pigments, properties of paint films attacked by fungi growth, and protection against fungi growth. (PVP-26)

**36.3.2.** Brown, et al, studied the mildew—preventing activity of rhodanine derivatives. Certain of these derivatives have been found effective in preventing rot of cotton cloth and the effect of variation in structure on the activity of some related derivatives has been studied.

The most active compounds in the series were 5-(p-chlorobenzylidine) rhodanine and 5-(2-thenylidene) rhodanine. Cotton strips impregnated with 1% concentration of the above substances lost not more than 15% of their tensile strength after burial in composted greenhouse soil for 4 weeks. The 5-substituted 2,4-dioxothiazolidines, while less effective than the corresponding 5-substituted rhodanines, in general, followed the same order of activity. (IEC-65)

**36.3.3.** Beaver, et al, describe the preparation of 17 new trisphenols by three procedures. Their physical properties and bacteriostatic activity against two types of bacteria and one fungus are shown. (JACS-10)

**36.3.4.** Nine 5-(1-methyl-2-thioalklethylidene)-rhodanines have been synthesized by condensation of rhodanines with alkyl acetonyl sulfides. Of the sulfides required for this work, by Brodsher, et al, seven are here reported for the first time. The fungistatic action of the new rhodanine compounds has been compared with that of the 5-(1-alkylethylidene)-rhodanines. (JACS-24)

**36.3.5.** Grupp reports on tests made by the Naval Research Laboratory on fungicide attenuation by oils. Some progress has been made but it is far from being satisfactory. Tests made at NRL indicate that the toxic non-pigmented finishes presently being made are of doubtful value. Salicylanilide seems to be better than most compounds as a fungicide when added to an organic protective coating. But on the whole there are no good fungicides for such application. Many compounds that are exceedingly toxic in vitro chemical tests are amazingly innocuous when added to protective coatings. (OF-31)

**36.3.6.** Bradsher, et al, have confirmed the reported toxicity of 2- and 3-phenanthrol toward *Aspergillus niger* and the toxicity has been shown to be general for some fluorenols and hydroxybiphenyls. Introduction of an alkyl group into the 4-, 6-, or 4'-position of 3-hydroxybiphenyl failed to enhance its fungistatic activity. (JACS-49)

**36.3.7.** In an investigation of phenylmecuric fungicides, it became desirable to determine why some formulations appeared to give better results than others. One possible explanation was that diphenylmercury, a relatively inactive material against the fungus under investigation, might be formed. Miller & Polley, describe procedures making possible the analysis of diphenylmercury, alone or in the presence of phenylmercuric compounds. A procedure is also given for the estimation of diethylmercury alone or in the presence of ethylmercuric compounds. (AC-18)

**36.3.8.** Buckman Labs., Inc. has issued 18-page Bulletin 4 PAM—Microorganism Control in the Paint Industry. Butrol properties and ease of use and handling are discussed followed by discussion of microorganism control in oil-base paints and in emulsion paints.

**36.3.9.** The Heyden Chemical Corporation has issued 16-page booklet describing Parasepts—Esters of Parahydroxybenzoic Acid—Versatile Preservatives.

**36.3.10.** The Naphthenate Preservatives Institute, Inc. has issued 24-page report on the Effectiveness of Copper Naphthenate as a Wood Preservative.

**36.3.11.** The Scientific Oil Compounding Company, Inc. has issued 3-page technical bulletin describing Cunimene D-2747, a new preservative for emulsion paints.

**36.3.12.** The Scientific Oil Compounding Company, Inc. has issued 4-page technical bulletin describing the preservation of glues and adhesives.

**36.3.13.** Scientific Oil Compounding Co., Inc. is now selling Cunimene D-2747, a Rosin Amine D. pentachlorophenate-containing (50%) fungicide and preservative for emulsion paints.

**36.3.14.** A new antifungal agent has been discovered by chemists of Sterling-Winthrop Research Institute, It's DL-threo-2-dichloroacetamido-1-(4methylsulfonylphenyl)-1,3-propenediol, shows significant activity against several species of fungi.

**36.3.15.** The order of antimicrobial activity of a group of common synthetic antifungal agents has recently been put on record by a research team at Osaka University, Japan. Compared for potency against bacteria, fungi and yeasts, five materials generally line up like this: (1) 8-hydroxyquinoline; (2) sodium pentachlorophenate; (3) 2-methyl-1,4-naphthoquinone; (4) butyl p-hydroxybenzoate; (5) dehydroacetic acid. The Japanese found that all but 8-hydrozquinoline and 2-methyl-1,4-naphthoquinone increased in effectiveness with increasingly acidic media. The former loses potency with mounting acidity; the latter is unaffected.

cf: 14.1.2
35.8.2
39.14.4
50.1.18

Manufacturers:
Advance Solvents & Chemical Corp.
Buckman Laboratories, Inc.
Carolina Aniline & Extract Company
Darworth, Inc.
The Dow Chemical Company
E. I. duPont de Nemours & Co., Inc.
Ferro Chemical Corp.
The Harshaw Chemical Company
Heyden Chemical Corp.
Innis, Speiden & Co., Inc.
The McGean Chemical Company
Mallinckrodt Chemical Works
Monsanto Chemical Company
Mooney Chemicals, Inc.
Naftone, Inc.
Nuodex Products Co., Inc.
The Richfield Oil Corp.
Scientific Oil Compounding Co., Inc.
The Shepherd Chemical Company
Fred'k A. Stresen-Reuter, Inc.
Triangle Chemical Company

R. T. Vanderbilt Co., Inc.
Witco Chemical Company

### Metallic Soaps

**36.4.1.** Licata discusses the function of fatty acids in metallic soaps. Such soaps are compounds of metals and fatty acids, which are characterized by water repellency, solubility in some organic liquids, extremely small particle size, and purity of the metal content. It is concluded that the fatty acid does play an important function in determining the method of preparation, the physical properties, and ultimately the use of metallic soaps. (JAOCS-24)

**36.4.2.** The use of metallic soaps as catalysts in the study of autoxidation and polymerization has led to a number of theories on the mechanism of these catalytic reactions. Skellon reviews the recent work in this field. The methods used to prepare pure soaps are outlined and reference made to the failure to obtain pure chemical compounds in some cases and to the suggested formation of physical complexes. The more important properties of these compounds, their solubility in various solvents and the wide variation in reported melting-points is also discussed. (PM-56)

**36.4.3.** The function and efficiency of a metallic soap depends in major degree on the nature and purity of the organic or anionic radical and also on the exact form of its combination with the metal. Information on these points has tended to be vague and inadequate. Morley-Smith reviews some of those properties of the more important metal soaps which are most affected by either selection of raw materials or by manufacturing technique, and to do so with special reference to those employed in paint formulation. (PM-57)

**36.4.4.** Alexander reviews synthetic and analytical data on the structure of aluminum compounds with fatty acids. There is no evidence for the existence of mono- and tri-soaps, but $Al(OR)L_2$ and $Al(OH)L_2$ can both be prepared. The structure of aluminum soaps and some account of their physical properties in solution are given. (JOCCA-36)

**36.4.5.** Stewart presents the results of a study to compare the metals as drying catalysts to determine their merits as compared to the metals in common use today. Thirty-five metals were included in these tests. The vehicles were a white interior air-dry alkyd enamel, a gloss white baking enamel, a white exterior oil paint, and a white interior oleoresinous enamel. More will be added and so contribute additional useful information. The ultimate purpose of this work is to completely evaluate the metal soaps for all film properties and possible specialty uses. (OD-43)

**36.4.6.** Stumpf presents a comparison of free fatty acid content and melting point determination of metallic stearates. The melting points of most of the metallic stearates, as reported by various investigators have been observed to vary widely. The purpose of the work was to correlate the variance in melting points with the content of free fatty acids found in the soap. It is concluded that:

1. There is a relationship between free fatty acid control and melting point.
2. The grade of acid used greatly affects melting point.
3. A higher melting point acid will produce a metallic stearate with higher softening and melting point range than an acid with lower melting point and lower purity of stearic acid.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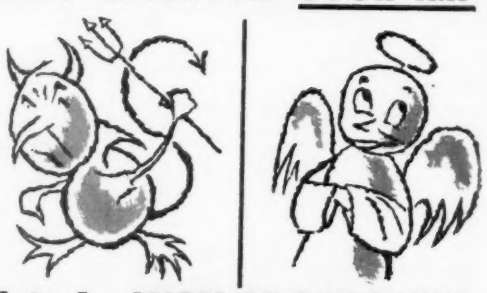

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4. Variance in melting points reported may be attributed to the free fatty acid content in the soap and the melting point of the acid used.
5. The softening and melting points of any metallic stearate varies inversely with the free fatty acid content of the metallic soap. (APJ-18)

**36.4.7.** Cheremisinoff & Stumpf studied the metallic salts of sebacic acid to extend the scant information on these salts and to determine gelling (if any), physical and other properties, and be able to compare them with properties of monobasic metallic salts of fatty acids. Salts of adipic and azelaic acid were not studied as their solubilities and other properties did not markedly differ from sebacic.

Metal salts of dibasic acids have extremely high metal content and exhibit high softening and melting points. The metal sebacates are insoluble in organic solvents, though the aluminum salt indicates some compatibility with organic solvents by a slight swelling.

The sodium, potassium and lithium salts are the only ones soluble in water.

These salts from a practical standpoint of solution (except for aluminum) may be considered inert (APJ-23)

**36.4.8.** Mallinckrodt Chemical Works has issued data sheets X-234, X-251, & X-248 describing aluminum stearates technical D, T, & M.

**36.4.9.** Mallinckrodt Chemical Works has issued data sheets X-243 describing calcium stearate —technical, bulky, grade A, and impalpable, powder, grade A.

**36.4.10.** Mallinckrodt Chemical Works has issued data sheet X-239 describing zinc stearate USP XIV Grade S.

**36.4.11.** The Witco Chemical Company has issued Bulletin G-5 describing Witco gelling agents (sodium stearate and aluminum stearate) for polyvinyl chloride compositions.

cf: 36.9.1
Manufacturers:
Advance Solvents & Chemical Corp.
American Cyanamid Company
The Harshaw Chemical Company
Mallickrodt Chemical Works
Metasap Chemical Company
M. W. Parsons-Plymouth, Inc.
Fred'k A. Stresen-Reuter, Inc.
Witco Chemical Company

**Surface Active Agents**

**36.5.1.** Mankowich discusses properties of surfactants. Six interrelated physicochemical factors of the detergency process were studied. These factors—surface tension, interfacial tension, contact angle, spreading coefficient, adhesion tension, and work of adhesion have been proposed as indexes of wetting and/or emulsification. (IEC-32)

**36.5.2.** Rainey & Denoon review a number of nonionic surface active agents. New sources of base materials and a variety of specialty applications—in cleaners, stabilizers, fertilizers, and therapeutic agents—point to a growing market for nonionic surface-active agents. (CEN-3)

**36.5.3.** Denning & Daniel discuss the effect of surface active agents on pigment-vehicle systems. Flow Point determinations with three vehicles, six pigments and five surface active agents show that dispersability does not depend on either the pigment alone, or the vehicle alone, or on the surface active agent alone. It depends on the combination of all three components. Therefore, it is futile to expect any single agent to be effective in all pigment-vehicle systems. The best that can be hoped for, is to find a compromise addition agent beneficial

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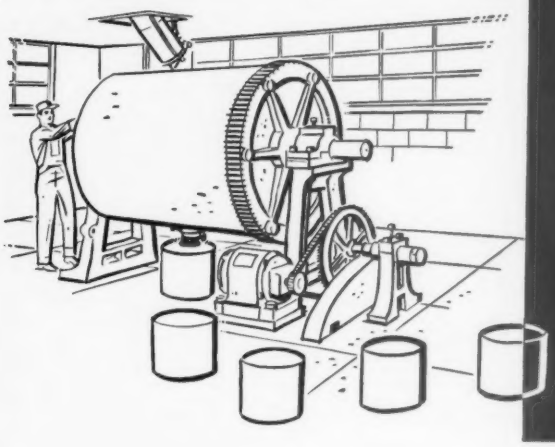

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**36.5.4.** Bramston-Cook and Elwell review the alkylbenzenes. The utility of alkylbenzene sulfonates for surface active applications is dependent in large part on the nature of the alkyl group used. (IEC-81)

**36.5.5.** Jelinek & Mayhew review the nonionic detergents composed of nonionic surfactants. Desirable improvements of nonionics include the development of a nonionic detergent formulation of higher foam stability, and the development of a solid nonionic possessing more efficient surface active properties. (IEC-82)

**36.5.6.** Kapella, et al, discuss a study on the detergency evaluation of some nonionic derivatives of tall oil. The study involves the preparation of derivatives such as the chloro-, bromo-, hydroxy-formoxy-, etc., of the hydrophobic unsaturated and various urethanes and esters of the hydrophilic hydroxyl group. Detergency values of all of the derivatives synthesized from the polyethenoxy tallate were determined on built mixtures. (JAOCS-33)

**36.5.7.** The American Cyanamid Company has issued a 44-page booklet describing properties and uses of the "Aerosol" Surface Active Agents.

**36.5.8.** The Armour Chemical Division has issued 21-page booklet describing Ethofats, Ethomids and Ethomeens—unique cationic and non-ionic surface active chemicals.

**36.5.9.** The Atlas Powder Company has developed the "HLB Surfactant Selector". This circular slide-chart is a time-saving, easy way to choose surfactants—by matching the HLB (Hydrophile-Lipophile Balance) numbers of Atlas surfactants with the HLB numbers most desirable in the end product.

**36.5.10.** The Geigy Chemical Corporation has issued four technical bulletins describing the Sarkosyls, their anti-corrosion properties, Sarkosyl NL-30 and Sarkosyl NL-100, surface active agents.

**36.5.11.** The Geigy Chemical Corporation has issued 2-page technical bulletin describing Alrosol B, a liquid nonionic diethanolamine-fatty acid condensate.

**36.5.12.** The Glyco Products Company, Inc. has issued 24-page booklet describing Esters by Glyco, surface active agents, emulsifying agents, wetting agents.

**36.5.13.** The National Aniline Division, has issued 4-page Technical Bulletin No. 326 describing Physical and Chemical Properties and Suggested Uses for Nacconal SL, an anionic surface active agent.

**36.5.14.** The Nopco Chemical Company has issued 11-page Technical Service Data Bulletin Misc 20A describing Nopco wetting agents.

**36.5.15.** The Oronite Chemical Company has issued data sheets describing properties and uses of Oronite Alkane, D-40, D-60 dry detergents, Oronite sodium sulfon-


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ates, and Oronite wetting agents and other surface active agents.

**36.5.16.** The Pacific Lumber Company has issued 5-page bulletin describing Palcotan and Palconate surface active agents.

**36.5.17.** The Rohm & Haas Company has issued Technical Bulletin SAN—230 describing Triton AS-30, anionic surface active agents.

**36.5.18.** The Rohm & Haas Company has issued Technical Bulletin SAN—231 describing AS-35, anionic surface active agent.

**36.5.19.** The Rohm & Haas Company has issued Technical Bulletin SP-127 describing the Priminox Series of polyethoxy Amines, surface active agents.

**36.5.20.** Sharples Chemicals Inc. has issued Data Sheet C-54 describing properties and uses of Nonic 300, a non-ionic type surface active agent.

**36.5.21.** The West Virginia Pulp & Paper Company has issued 7-page Technical Bulletin No. 301 describing properties and uses of Polyfon sodium lignosulfonates—surface active agents.

Manufacturers:
American Cyanamid Company
Antara Chemicals
Armour Chemical Division
Atlas Powder Company
Carbide & Carbon Chemicals Company
Commercial Solvents Corp.
Geigy Industrial Chemicals
The Girdler Company
Hercules Powder Company
Kraft Chemical Company, Inc.
National Aniline Division
Nopco Chemical Company
Nuodex Products Co., Inc.
Oronite Chemical Company
The Pacific Lumber Company
Petrochemicals Company
Raybo Chemical Company
Rohm & Haas Company
Sharples Chemicals, Inc.
West Virginia Pulp & Paper Company
Wyandotte Chemicals Corp.
R. T. Vanderbilt Co., Inc.

### Grinding & Dispersing Aids

**36.6.1.** Kronstein reviews the use of lecithin in pigment dispersion. The effect of lecithin on the dispersion of rutile and of anatase titanium dioxide in latex paints was investigated, together with its effect on the behavior of the pH and viscosity of the paint system.

Results show that the use of lecithin in the preparation of paints increases the speed in which pigment dispersion takes place, thus causing the viscosity of the paint to reach a particular level at a faster rate. These paints also show a steady viscosity level during ten weeks of storage. The addition of lecithin to a prepared paint shows less effect on the paint in subsequent storage.

The preferred amount of lecithin employed in these studies was 1% based on the pigment content. (PVP-32)

**36.6.2.** R. T. Vanderbilt Co., Inc. has issued 4-page bulletin on Darvan No. 1 and Darvan No. 2 describing the properties and uses of these dispersing agents.

**36.6.3.** Nuodex Products Co., Inc. is now introducing its latest paint additive, a grinding aid and dispersing agent—tagged Nuosperse.

Manufacturers:
Advance Solvents & Chemical Corp.
Glyco Products Company, Inc.
Nopco Chemical Co.
Nuodex Products Co., Inc.
R. T. Vanderbilt Co., Inc.

### Emulsifiers

**36.7.1.** Atlas Powder Company presents ten tips on preparing and formulating emulsions. Two series of photographs are presented;


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- The hardest of pigments are rapidly deflocculated.
- Pigments treated with Sotex agents are softer and will disperse faster.
- Flooding and flocculation of the final product is appreciably reduced, due to the uniformity of particle size in the dispersion.
- Dispersions containing Sotex agents improve gloss of enamels and gloss finishes.
- The Sotex agents are specific types of non-ionic and cationic surfactants and are to be used as recommended.

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## SYNTHETIC CHEMICALS, INC.

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**Paterson 4, N. J.**

**Phone**
**Mulberry 4-1726-7**

**Cable Address**
**Patchem Paterson**

the first dealing with water in oil emulsions, the second with oil in water emulsions. (PVP-25)

**36.7.2.** The Atlas Powder Company has issued 74-page booklet —"A Guide to Formulation of Industrial Emulsions with Atlas Surfactants".

**36.7.3.** The Dow Chemical Company has issued 22-page booklet describing Dow Ethanolamines, emulsifying agents.

**36.7.4.** The Emulsol Corporation has issued 3-page Technical Bulletin No. 38 describing Emcol H-50A, hydrocarbon solvent emulsifier.

**36.7.5.** The Hercules Powder Company has issued 16-page booklet describing Dresinate emulsifiers, detergents and dispersants.

**36.7.6.** The Jefferson Chemical Company Inc. has issued 40-page Technical Bulletin describing properties and uses of mono, di, and tri-ethanolamine, emulsifying agents.

**36.7.7.** The Nopco Chemical Company has issued 3-page Technical Service Data Bulletin describing Monosulph, an emulsifier for water paints.

**36.7.8.** The Oronite Chemical Company has issued data sheets describing properties and uses of Dispersant NI-W and Dispersant NI-O, emulsifying agents.

**36.7.9.** Sharples Chemicals Inc. has issued Report 54-4 describing Sharples emulsifier amines for water emulsion floor polishes.

Manufacturers:
Antara Chemicals
Armour Chemical Division
Atlas Powder Company
Carbide & Carbon Chemicals Company
The Dow Chemical Company
Emery Industries, Inc.
The Emulsol Corp.
Geigy Industrial Chemicals
Hercules Powder Company
Jefferson Chemical Company, Inc.
Kraft Chemical Company, Inc.
Nopco Chemical Company
Oronite Chemical Company
Petrochemicals Company
Sharples Chemicals, Inc.
Universal Chemicals Corp.
Wyandotte Chemicals Corp.

### Stabilizers

**36.8.1.** Ronai & Weisberg discuss the use of modified proteins to stabilize latex paints. The reaction between protein stabilizers & polyvalent cations in a latex paint usually causes a great viscosity increase and makes the paint unusable. Proteins modified to be insensitive to polyvalent cations could help prevent this. Modification of a protein could affect its capacity to make stable emulsions, thereby improving freeze-thaw stability. (IEC-53)

**36.8.2.** Hundreds of compounds have been suggested as stabilizers to protect polyvinyl chloride against breakdown by heat and light. Mack reviews the theory of the action of the stabilizers and discusses the merits of the various commercial types, including lead, calcium, strontium, barium, tin, cadmium, and zinc compounds.

Recent developments in epoxy stabilizers and chelating materials are described. The latter are complexing agents which serve to clear up haziness caused by some metallic compounds as well as to improve the stabilization of the vinyl resin. Synergistic effects are obtained by the use of combinations of metallic stabilizers, resulting in greater protection than is imparted by either component used alone in like quantity. (MP-8)

**36.8.3.** A plasticised, heat- and light resistant, stably compatible composition comprising a resin selected from the group consisting of homopolymers of vinylidene chloride and copolymers thereof with up to 15%, based on the weight of said copolymers, of other unsaturated compounds copolymerizable therewith, together with


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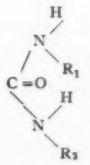
from 0.5 to 10%, based on the weight of said resin, of a chlorosubstituted phenyl benzoate selected from the group consisting of the following compounds:
Phenyl p-chlorobenzoate
Phenyl o-chlorobenzoate
p-Chlorophenyl benzoate
p-Chlorophenyl p-chlorobenzoate
p-Chlorophenyl o-chlorobenzoate
p-Chlorophenyl 3,4-dichlorobenzoate
o-Chlorophenyl benzoate
o-Chlorophenyl p-chlorobenzoate
o-Chlorophenyl o-chlorobenzoate
2,4,6-trichlorophenyl benzoate
2,4,6-trichlorophenyl p-chlorobenzoate
2,4,6-trichlorophenyl o-chlorobenzoate
2,4,6-trichlorophenyl 3,4-dichlorobenzoate
2,4,6-trichlorophenyl 2,4-dichlorobenzoate
Pentachlorophenyl benzoate
(USP-76)

**36.8.4.** A heat-stabilized composition comprising a crystalline resin selected from the group consisting of polymers of vinylidene chloride and copolymers thereof with other ethylenically unsaturated compounds copolymerizable therewith, said copolymers containing at least 80% of vinylidene chloride copolymerized therein, together with from 0.5 to 4.0% of pentachlorophenoxy propene oxide homogeneously compounded therewith, said percentages being on the basis of the weight of said resin. (USP-77)

**36.8.5.** A method of stabilizing an emulsion copolymer comprising an aromatic vinyl compound containing a single center of unsaturation and a conjugated diolefin



U. S. Patent No. 2,683,699

having the qualities essential to a paint latex which comprises dispersing therein from 1% to 15% of a water-soluble compound containing a ureylene nucleus wherein $R_1$ and $R_2$ are radicals selected from the group consisting of hydrogen, hydroxyl, alkyol and alkyl radicals containing not more than four carbon atoms wherein the sum of the carbon atoms in $R_1$ plus $R_2$ does not exceed 5. USP-152)

**36.8.6.** The Carbide & Carbon Chemicals Company has issued 2-page Bulletin F-8426 describing properties and uses of stabilizer D-22, dibutyl in dilaurate.

**36.8.7.** The Metal & Thermit Corporation has issued Technical Data Sheets 112, 122, and 123 describing Thermolite 31, 14, and 99, a series of stabilizers for vinyls and other chlorinated organic compounds.

**36.8.8.** The Minnesota Mining & Manufacturing Company has issued 4-page Report No. 2 describing RD-910 Latex Paint Stabilizer-Thickener.

**36.8.9.** The Witco Chemical Company has issued Bulletin S-8 describing Witco Stayrite #229, a lead compound for stabilizing halogen containing organic materials.

Manufacturers:
Advance Solvents & Chemical Corp.
Carbide & Carbon Chemicals Company
Ferro Chemical Corp.
The Harshaw Chemical Company
Harwick Standard Chemical Company
Metal & Thermit Corp.
Minnesota Mining & Mfg. Company
National Lead Company
Nopco Chemical Company
Witco Chemical Company

### Thickeners

**36.9.1.** Rodriguez discusses the peptization of aluminum soap-mineral spirits mixtures. The purpose of this work was to evaluate the effect of certain polar compounds on the gelling rate and equilibrium viscosity of aluminum octoate-mineral spirits mixtures at room temperatures. (APJ-39)

**36.9.2.** A method of making a mixture of water with a zein solution, which consists in dissolving the zein initially in a substantially anhydrous glycol which is a primary solvent for zein, said glycol being substantially non-volatile at 130° C. under a pressure of 760 mm. of mercury and having a critical peptization temperature whose maximum is minus 40° C. to make an initial substantially anhydrous solution which remains clear and stable at 21° C. for at least six weeks, and then adding water to said initial solution, the water being added sufficiently slowly and with sufficiently vigorous agitation to blend with said initial solution without precipitation of

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New York 19, N. Y.

the zein, the weight of the added water being at least 10% of the weight of the mixture and being within the water tolerance of said primary solvent. (USP-47)

**36.9.3.** The American Polymer Co. has issued Bulletin P-27 on Acrylic Thickeners and Protective Colloids Polycos 296 and 296N.

**36.9.4.** The Attapulgus Minerals & Chemicals Corporation has issued 8-page Bulletin No. P53 describing "Permagel—the ideal bodying and thickening agent in organic or water systems".

**36.9.5.** The Burtonite Company, has issued Technical Data bulletin on Burtonite #7, a cold water soluble gum made from Guar seeds. Used as a protective colloid, thickener, and film forming agent.

**36.9.6.** The B. F. Goodrich Chemical Co. has issued Service Bulletin GC-20 describing properties and uses of Carbapol 934, an unique water sensitive gum, useful as an emulsion paint thickener.

**36.9.7.** The Nopco Chemical Company has issued 3-page Technical Service Data Bulletin Misc. 36a—"Higher Latex Paint Thickening Efficiency with Modicol VD".

cf: 40.1.3
Manufacturers:
Advance Solvents & Chemical Corp.
Brown-Allen Chemicals, Inc.
Buckeye Cotton Oil Company
Carbide & Carbon Chemicals Company
Croda Incorporated
Minnesota Mining & Mfg. Company
National Lead Company
Nuodex Products Co., Inc.
Raybo Chemical Company
Rohm & Haas Company
Witco Chemical Company

### Waxes

**36.10.1.** Johnson studied solid-solid transitions in commercial paraffin waxes and normal straight-chain hydrocarbons by measuring the refractive index as a function of temperature. Typical waxes have solid-state transitions similar to those of the normal straight-chain hydrocarbons in the same molecular weight range.

Because few properties of waxes in the solid state can be measured conveniently and accurately, use of the information obtained by this method should lead to a better understanding of the behavior of waxes. (IEC-56)

**36.10.2.** The ASTM Wax Polishes Committee presents two suggested methods relating to carnauba and other waxes. The first is a method for concentrating additives of carnauba wax and other high-melting point natural and synthetic waxes. The second is a suggested method of test for the index of refraction of carnauba wax and other high-melting point natural and synthetic waxes. (ASTM-10)

**36.10.3.** Knol reviews the aliphatic woolwax alcohols. The composition of the group of aliphatic woolwax alcohols has been the subject of investigation by many chemists for more than 60 years. Systematic research started in 1951. Twenty-two alcohols have been isolated, belonging to four series of alcohols: normal alcohols, diols, iso, and ante-iso branched chain alcohols. None of the investigators mentions the presence of unsaturated alcohols. About 25% of the woolwax alcohols is still unknown material and waiting for further elucidation. (JAOCS-14)

**36.10.4.** It should be possible to produce plastics from peat wax. Molecular structure suggests potential chemical uses. Peat wax consists of a series of high molecular weight organic compounds containing three or more functional groups such as carboxylic acid, ester and hydroxyl. An arbitrary division can be made of crude wax into resins, true wax and asphalt. (CEN-20)

**36.10.5.** An emulsifier composition comprising (*a*) a mixture of lipophilic partial ester of a long chain fatty acid and a hydrophilic polyhydroxylic organic compound, a highly hydrophilic hydroxy-polyoxyethylene ether of a lipophilic partial ester of a long chain fatty acid and a hydrophilic polyhydroxylic organic compound, said hydroxypolyoxyethylene ether containing at least 10 oxyethylene groups; said partial ester and said hydroxypolyoxyethylene ether being present in the mixture in such proportions that the ratio of oxyethylene groups in said hydroxypolyoxyethylene ether to the total ester groups (both in the free ester and in the hydroxypolyoxyethylene ether) is in the range of from about 1.5 to 9.0 and (*b*) from about 3% to about 25% by weight, based on the weight of the said mixture, of a hexitol monoborate the pH of which has been adjusted to a value between 4.5 to 9.0 by replacement of acid hydrogen of the said monoborate with a monovalent cation other than hydrogen.

An emulsifiable wax consisting essentially of from 70% to 90% paraffin wax and from 30% to 10% of the emulsifier composition of claim 1. (USP-155)

**36.10.6.** The Glyco Products Company, Inc. has issued 16-page booklet describing Synthetic Waxes by Glyco.

**36.10.7.** The Frank B. Ross Co., Inc. has issued 22-page Booklet describing Ross Waxes.

cf: 20.3.1
35.7.1
Manufacturers:
Bakelite Company
H. L. Barnebey
Dura Commodities Corp.
Glyco Products Co., Inc.
National Wax Company
Frank B. Ross Company
Standard Oil Co. of Calif.

### Anti-Foaming Agents

**36.11.1.** The Monsanto Chemical Company has issued technical data sheet describing defoamer PC 1244.

**36.11.2.** The Nopco Chemical Company has issued 2-page Technical Service Data Bulletin Misc. 17 describing Nopco Anti-Foamers for Latex Paints Nopco 1497-V, 1407, and 1907-B.

Manufacturers:
Dow Corning Corp.
El Dorado Oil Works
Glyco Products Co., Inc.
Kraft Chemical Company, Inc.
Monsanto Chemical Company
Nopco Chemical Company
Swift & Company

### Ultra-Violet Absorbers

**36.12.** (No abstracts)

Manufacturers:
American Cyanamid Company
Antara Chemicals

### Fire-Retardants

**36.13.1.** Method for the preparation of a stable solution capable of imparting fire resistance to a cellulosic material which comprises forming a mixture of water, hydrochloric acid and antimony trioxide and an organic acid selected from the group consisting of acetic acid and formic acid, and to said mixture subsequently adding substantially anhydrous titanium tetrachloride, meanwhile maintaining the temperature of said mixture be-

tween 30 and 50° C. during the addition of said titanium tetrachloride, said organic acid being added in an amount from 0.3 to 0.9 part by weight of organic acid for each part by weight of titanium tetrachloride, said antimony trioxide being added in an amount by weight from 0.46 to 0.7 part of antimony trioxide for each part by weight of titanium tetrachloride, said hydrochloric acid and said titanium tetrachloride being added in amount to give 0.16 part by weight of chloride, calculated as hydrochloric acid for each part by weight of antimony trioxide, and from 0.19 to 0.58 part by weight of chloride calculated as hydrochloric acid for each part by weight of titanium calculated as titanium tetrachloride and adding water in an amount to maintain in the final solution a concentration of between 120 and 160 grams of titanium per liter of solution. (USP-98)

**36.13.2.** An intumescing fire-retarding composition composed of the water-insoluble reaction product of phosphoryl chloride and anhydrous ammonia, said water-insoluble product having a nitrogen/phosphorus ratio between 1.72:1 and 1.80:1, in combination with an alkyd resin having free hydroxy radicals. (USP-129)

**36.13.3.** The American Potash and Chemical Corporation has issued Product Information Bulletin DEB—115 describing the properties and uses of Borotherm, a highly soluble borate composition.

**36.13.4.** The Metal & Thermit Corporation has issued Technical Data sheets 119 and 128 describing antimony oxide in vinyl plastics and presenting data on M & T Flame Retarder.

Manufacturers:
American Potash & Chemical Corp.
Metal & Thermit Corp.
Pacific Coast Borax Company.

### Anti-Skinning Agents

**36.15.** (No Abstracts)

Manufacturers:
Advance Solvents & Chemical Corp.
National Aniline Division
Nuodex Products Co., Inc.

### Deodorants

**36.14.** (No Abstracts)

Manufacturers:
Aromatic Products, Inc.
Dodge & Olcott, Inc.
Rhodia, Inc.
Sindar Corporation
Van Amerlingen-Haebler, Inc.

# INTERMEDIATES

CHAPTER 37

# INTERMEDIATES

### General

**37.1.1.** Adams describes the production of intermediates for azo pigments and lakes. Originally used in the dyestuffs industry, the term "intermediate" has now come to mean any organic chemical which is treated further chemically to produce such finished products as dyestuffs, lakes, insecticides, pharmaceutical products, etc. The intermediates are derived generally from coal tar distillation products such as benzene, toluene, xylene, and naphthalene by one or more chemical processes.

The following diazo components are discussed: 3-Nitro-p-toluidine, p-Nitroaniline, C-acid, and Tobias acid. The following coupling components are discussed: 2:3-Hydroxynaphthoic acid and Acetoacetarylides. (JOCCA-37)

**37.1.2.** Expanding acrylonitrile consumption and new acetylenics will boost chemical consumption of acetylene.

Acetylene chemistry is still in the early development stages; its future cannot be accurately evaluated. But there is no doubt that as technology makes more, cheaper, purer acetylene available chemistry will find many valuable uses for this versatile, convenient gas. (CEN-17)

**37.1.3.** Oswald makes some observations on the use of dimethyl isophthalate (DMI), a new alkyd raw material. Use of the alcoholysis reaction with DMI leads to the following advantages as compared with fusion esterification using phthalic anhydride:

1. greater latitude in choice of reaction temperature
2. elimination of sublimation problems
3. higher viscosity for a given polyol and oil length
4. lower acid number resins
5. more positive control of rate of viscosity increase
6. better color

(POCR-2)

**37.1.4.** The Sun Oil Company has opened a new petrochemical plant at Marcus Hook, Pa. Unknown 35 years ago, the petrochemical industry now supplies almost one-quarter of our chemical needs and promises to supply one-half by 1965. (PIM-5)

**37.1.5.** The method comprising heating a reaction mass consisting essentially of calcium cyanamide, ammonia and carbon dioxide at a temperature of at least about 65°C. and a pressure of at least 450 p.s.i. to produce a reaction mass containing at least one member of the group consisting of a guanidine salt and melamine. (USP-57)

**37.1.6.** The process of preparing melamine from biuret which consists of heating biuret at a temperature in the range of 300-350°C. in a closed vessel under a pressure of at least 100 lbs. per sq. inch, until melamine is formed and recovering the so-formed melamine. (USP-58)

**37.1.7.** The Commercial Solvents Corporation has issued Technical Data Sheet TDS—No. 22 describing anhydrous ammonia.

**37.1.8.** The Dow Chemical Company has issued 14-page technical bulletin describing chlorinated benzenes, chemical intermediates.

**37.1.9.** The Monsanto Chemical Company has issued 16-page Technical Bulletin No. O-116 describing reactions and properties of succinonitrile.

**37.1.10.** The National Aniline Division has issued Technical Bulletin Nos. 1-3 and 1-4 describing trans-1,2-dibenzoylethylene and 1, 4-naphtho-quinone.

**37.1.11.** The National Aniline Division has issued Technical Bulletin No. 1-7 describing fumaryl chloride.

**37.1.12.** The Nitrogen Division, has issued 33-page product bulletin describing properties and uses of ethylene oxide, ethylene glycol and diethylene glycol.

**37.1.13.** The Rohm & Haas Company has issued 11-page Technical Bulletin SP-98 describing octylphenol and nonylphenol.

**37.1.14.** A new intermediate in the production of epoxy resins is the latest offering of Irvington Varnish and Insulator Division of Minnesota Mining and Manufacturing Co., Irvington, N. J. Trade named Cardolite 6463, the product is a phenol, containing a 15-carbon substituted straight chain in the metaposition, Molecular weight: 410, nearly twice that of the usual bisphenol. According to Irvington, Cardolite 6463 requires about half the quantity of epichlorhydrin normally used in the preparation of epoxies, imparts greater flexibility to the cured resin.

### Polybasic Acids

**37.2.1.** Defense Production Administration goal set for phthalic anhydride facilities hasn't appealed to many chemical companies. One of the five companies filing for write-offs has cancelled, another is still undecided whether to expand. The three others—Allied, Cyanamid and Monsanto—are due to boost production by some 80 million lbs. before January 1, 1953. (CW-4)

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**Hexahydro Phthalic Anhydride Tetrahydro Phthalic Anhydride**
**Nadic Anhydride Adipic Acid Succinic Anhydride**
**Maleic Acid Malic Acid Succinic Acid**
**Metaphenylenediamine Dodecenylsuccinic Anhydride**

**ANTI-SKINNING AGENTS**
**National ASA National Anti-oxidant B**

**NATIONAL ANILINE DIVISION**
ALLIED CHEMICAL & DYE CORPORATION
40 RECTOR STREET, NEW YORK 6, N Y · HAnover 2-7300

Allied Chemical

Boston Providence Philadelphia Chicago San Francisco Portland, Ore Greensboro
Charlotte Richmond Atlanta Columbus, Ga New Orleans Chattanooga Toronto

**37.2.2.** Gardner discusses maleic anhydride adducts. The major uses of maleic anhydride have been confined to the protective coatings field wherin more than 86% of the total production of maleic anhydride is used. Major uses include alkyd resins, polyester and styrene resins, and plasticizers. (PVP-24)

**37.2.3.** By the end of 1954 National Aniline Division of Allied Chemical & Dye Corp., will have added 10 million lbs. to U. S. maleic anhydride capacity and about 1 million lbs. to its fumaric capacity.

Maleic anhydride tops fumaric acid use in styrenated polyesters. Fumaric acid gives a higher heat-distortion temperature to a resin than does maleic anhydride, other things being equal.

Substitution of fumaric acid for maleic anhydride is on a mole-for-mole basis; therefore a greater weight of fumaric acid is required to replace a functionally equivalent weight of maleic anhydride.

In alkyds, its been found that the substitution of fumaric acid for phthalic anhydride—to the extent of 1.5-3% of total alkyd resin weight—improves resulting protective coatings. Films dry faster, become harder and more durable, resist water and alkalis, have clearer colors that are retained longer than when none of the phthalic anhydride is replaced. (CW-17)

**37.2.4.** The American Cyanamid Company has issued 24-page booklet on "Aero Phthalic Anhydride" listing properties and methods of handling.

**37.2.5.** The American Cyanamid Company has issued 2-page bulletin describing properties and uses of Aero maleic anhydride.

**37.2.6.** The Carbide & Carbon Chemicals Company has issued 32-page technical booklet describing uses and properties of organic acids.

**37.2.7.** E. I. du Pont de Nemours & Co. (Inc.) has issued 6-page technical bulletin describing properties and uses of pyromellitic acid, a new polycarboxylic acid.

**37.2.8.** E. I. du Pont de Nemours & Co. (Inc.) has issued 4-page technical bulletin describing properties and uses of isocinchomeronic acid, a new heterocyclic dibasic acid.

**37.2.9.** Emery Industries, Inc. has issued 16-page booklet describing properties and uses (general applications and in surface coatings) of Emery 955 Dimer Acid, a dibasic acid of approximately 600 molecular weight.

**37.2.10.** Emery Industries, Inc. has issued Technical Bulletin No. 40-A describing Emerox 1110 Azelaic acid, $C_7 H_{14} (COOH)_2$.

**37.2.11.** The Hercules Powder Company has issued 4-page bulletin describing properties and uses of Hercules DMT, dimethyl terephthalate.

**37.2.12.** Koppers Company, Inc. has issued 4-page bulletin #C-O-44 describing properties and uses of phthalic anhydride.

**37.2.13.** The Monsanto Chemical Company has issued 10-page Technical Bulletin No. 0-115 describing "Fumaric Acid in Coating and Polyester Resins".

**37.2.14.** The National Aniline Division has issued Technical Bulletin Nos. I-1 and I-2 describing tetrahydro phthalic anhydride and hexahydro phthalic anhydride.

**37.2.15.** The National Aniline Division has issued Technical Bulletins Nos. I-5 and I-6 describing "nadic" anhydride and beta benzoyl-acrylic acid.

**37.2.16.** The National Aniline Division has issued Technical Bulletins Nos. I-8 and I-9 describing dodecenyl-succinic anhydride and thiomalic acid.

**37.2.17.** Chas. Pfizer & Co., Inc. has issued 6-page Technical Bulletin No. 46 describing properties and uses of fumaric acid, an unsaturated dibasic acid.

**37.2.18.** The Shell Chemical Corporation has issued 4-page bulletin SC:54-33 describing p-tert-butylbenzoic acid. Bulletin SC:51-25 describes the use of this acid in surface coating resins.

**37.2.19.** The Velsicol Corporation has issued 13-page booklet describing properties and uses of chlorenic acid and chlorenic anhydride.

cf: 50.3.1

Manufacturers:
American Cyanamid Company
Archer-Daniels-Midland Company
Carbide & Carbon Chemicals Company
E. I. duPont de Nemours & Co., Inc.
Emery Industries, Inc.
Hercules Powder Company
Koppers Company, Inc.
Monsanto Chemical Corp.
National Aniline Division
Chas. Pfizer & Co., Inc.
Shell Chemical Corp.
Velsicol Corp.

### Polyols

**37.3.1.** Pattison reviews glycerine—today and tomorrow. It seems safe to say that 1954 will find glycerine supply fully adequate to meet the demands of an economy of abundance. It should be free from the "feast or famine" effects that have driven customers to seek substitutes in the past, or to anticipate indigestible market gluts. (PVP-28)

**37.3.2.** Pattison discusses the use of glycerine in industrial finishes. About one-third of all the glycerine produced in this country is used in industrial finishes, as synthetic resins. Glycerine is used in alkyd resin manufacture, where it permits flexibility in alkyd resin formulations. Alkyds blended with other resins improve the properties of both (OF-14)

**37.3.3.** Balgley discusses trimethylolethane (TME), a new polyol for the coatings industry. Advantages of TME in alkyds include: light initial color, good color retention, hardness, fast dry, excellent alkali resistance compared to other alkyds, good durability, heat stability, compatibility with amino resins, fast alcoholysis, and non-volatility. (APJ-29)

**37.3.4.** Balgley describes trimethylolethane (TME) a new polyol for the coatings industry. Advantages of TME in alkyds are as follows:

1. light initial color
2. good color retention
3. hardness
4. fast dry
5. excellent alkali resistance compared to other alkyds
6. good durability
7. heat stability
8. compatibility with amino resins
9. fast alcoholysis
10. non-volatile

(PIM-20)

**37.3.5.** A substantially homogeneous liquid composition consisting of a dispersion of at least one alkali salt of a sulphonated alkenyl aromatic resin, containing an average of from 0.55 to 0.95 sulphonate radical per aromatic nucleus, in a liquid medium of the group consisting of at least one

saturated aliphatic polyhydric alcohol containing from 2 to 6 carbon atoms, and having a ratio of from 1 to 1.5 carbon atoms per atom of oxygen, in the molecule, and aqueous solutions of such saturated aliphatic polyhydric alcohols in a concentration of at least 30 per cent by weight, said salt of the sulphonated alkenyl aromatic resin being present in an appreciable proportion not greater than 10 per cent of the combined weight of the same and the liquid medium. (USP-99)

**37.3.6.** The Atlas Powder Company has issued 16-page booklet "Sorbitol Resins" describing the use of Sorbitol, a versatile polyol for alkyd and resin synthesis.

**37.3.7.** The Glycerine Producers' Association has issued 19-page bulletin on Glycerine—for product conditioning.

**37.3.8.** The Heyden Chemical Corporation has issued 10-page revised Technical Data Sheet PE-10 describing properties and uses of TME—trimethylolethane, a solid trihydric alcohol.

**37.3.9.** The Heyden Chemical Corporation has issued 32-page booklet "Pentek Resins for Protective Coatings of Enduring Beauty, High Resistance to Water, Weather and Severe Service. These resins are based on Pentek, pentaerythritol (tetramethylolmethane).

cf: 14.2.1
Manufacturers:
Atlas Powder Company
Commercial Solvents Corp.
Eastman Chemical Products, Inc.
Wyandotte Chemicals Corp.

### Aldehydes

**37.4.1.** There is good reason to believe that the United States will reach its formaldehyde goal of 1,675 million lbs. capacity by 1955. (CW-6)

**37.4.2.** The Celanese Corporation of America has issued 28-page Formalin Handling Manual. This manual covers specifications for formaldehyde, receiving and unloading, temperature control, temperature-density table, storage, safety & personnel protection, and methods of analysis.

**37.4.3.** The Westvaco Chemical Division has issued 4-page Technical Data Sheet S-7 (Revised) describing properties and reactions of dichloroacetaldehyde.

**37.4.4.** The Westvaco Chemical Division has issued 26-page Technical Bulletin No. 206 describing Chloral, trichloroacetaldehyde.

Manufacturers:
Celanese Corp. of America
Commercial Solvents Corp.
Heyden Chemical Corp.
Westvaco Chemical Division

### Phenols

**37.5.1.** Given a healthy assist from a flood of new cumene-phenol plants on which construction started this year, the Defense Production Administration's goal for phenol production by January 1, 1955 is already assured of being met. The goal: an additional 280 million lbs. above 1951 capacity of 343 million lbs. (CW-1)

**37.5.2.** Phenol supply is still "in balance" as new developments expanding outlets push demand skyward, blot up surplus production capacity. Defense Production Administration set a January 1955 goal of 623 million lbs. But kinks in new phenol-from-cumene process threaten to tighten the market unless straightened out by 1955. (CW-9)

**37.5.3.** Plant in California starts production of phenol, via cumene, from 100% petroleum sources, Output: 17,500 tons. (CEN-7)

**37.5.4.** The Monsanto Chemical Company has issued 32-page booklet on the Handling of Phenol.

Manufacturers:
Monsanto Chemical Company
Rohm & Haas Company

### Monomers

**37.6.1.** Dow's styrene oxide, outgrowing its pilot plant, is being geared up to commercial production. Styrene glycol, made directly from styrene oxide, may be used to modify alkyd resins. Other interesting resins result from the polymerization of styrene oxide with phenol, vinyl halides and vinylidine halides. (CW-7)

**37.6.2.** Coffman & Jenner have obtained the acetates of alcohols containing from one to several styrene units, by the ionic telomerization of styrene with acetic acid. Esters containing 1,2, and 3 units have been isolated. From styrene and acetonitrile, acyl derivatives of primary amines having a number of styrene units have been obtained, and amines from the first two members have been identified. Styrene & HCHO in acetic acid have given the acetates of glycols containing one methylene group and and a variable number of styrene units. (JACS-53)

**37.6.3.** Frankel, et al, report that acyl chlorides hydrochlorides of amino acids and peptides undergo polymerization, yielding polymeric polypeptides. This method is applicable in cases where N-carboxy-anhydrides cannot be obtained, as with $\beta$-amino acids and peptides. (JACS-54)

**37.6.4.** Fuhrman & Mesrobian measured the chain transfer constants of six vinyl monomers with carbon tetrabromide at several temperatures. The monomers employed, in the order of their decreasing transfer constant at 60° are: vinyl acetate, p-chlorostyrene, styrene, methyl acrylate, methyl methacrylate and methacrylonitrile. The results indicate that ionic forms in the transition state, similar to those involved in radical addition to double bonds, contribute to the reactivity of radicals in transfer reactions. (JACS-56)

**37.6.5.** Hush presents a quantum-mechanical discussion of the gas-phase formation of quinonedimethide monomers. Included are: formation of monomers, alternate SQDM reactions, energies and kinetics of elementary steps, calculation of unsaturation energies, comparison with experiment, excited states of QDM monomers, crosslinkage, and conclusion. (JPS-1)

**37.6.6.** Vinyltoluene, first cousin to styrene, has a big future in store. It is compatible over a much larger range of drying oils than is styrene. VT's ease of reaction is an improvement over styrene resulting in economies. VT-drying oil copolymers possess infinite tolerance for petroleum naphtha solvents of low Kouri butanol value. (POCR-11)

**37.6.7.** Isocyanates are compounds characterized by the polyfunctional group $-N=C=O$. They are highly reactive compounds. The reaction of an alcohol with an isocyanate results in a linear polymer. Currently the isocyanates are largely in the development stage in this country. (POCR-13)

**37.6.8.** Henson reviews and discusses vinyltoluene—a new spoke in the vehicle wheel. Chemically

it is methylstyrene. An entirely new class of vehicles made possible by a combination of vinyltoluene and divinylbenzene shows strong possibilities for the preparation of vehicles closely resembling oil modified alkyds in many important characteristics. (POCR-14)

**37.6.9.** Henson discusses vinyltoluene a new monomer for vehicle manufacture, Vinyltoluene, which can also be called methylstyrene, is related to styrene hence a vinyl monomer. The introduction of vinyl monomers results in modified or upgraded vehicles. (APJ-16)

**37.6.10.** Henson discussed vinyltoluene, a new spoke in the vehicle wheel. Vinyltoluene is related to polystyrene—another name for it being methylstyrene. This monomer opens an entirely new and scarcely explored field of vehicle chemistry. The speed and readiness with which it reacts with oils and oil modified alkyds is very favorable. (PIM-4)

**37.6.11.** The Carbide & Carbon Chemicals Company has issued 8-page technical bulletin describing properties and uses of acrylonitrile (vinyl cyanide).

**37.6.12.** The Dow Chemical Company has issued 5-page bulletin describing butylene oxides S used directly for polymerization and condensation type reactions.

**37.6.13.** The Dow Chemical Company has issued 47-page bulletin on vinyltoluene for use in paints and varnishes.

**37.6.14.** The Dow Chemical Company has issued 21-page bulletin describing properties and uses of vinyl chloride monomer.

**37.6.15.** Koppers Company, Inc. has issued 36-page Technical Bulletin C-4-119 describing properties and uses of styrene monomer.

**37.6.16.** Koppers Company, Inc. has issued 23-page bulletin describing properties and uses of styrene monomer.

**37.6.17.** The Rohm & Haas Company has issued 32-page Technical Bulletin SP-42 describing properties and uses of calcium acrylate, a monomeric, water-soluble salt, which will polymerize in the presence of catalyst.

**37.6.18.** The Rohm & Haas Company has issued 14-page bulletin SP-88 describing properties, handling and reactions of glacial methacrylic acid.

**37.6.19.** The Rohm & Haas Company has issued 2-page bulletin SP-139 describing properties and uses of methoxyethyl acrylate and butoxyethyl acrylate.

cf: 16.2.2
18.1.1

Manufacturers:
American Momomer Corp.
Carbide & Carbon Chemicals Company
The Dow Chemical Company
Koppers Company, Inc.
Monsanto Chemical Company
National Aniline Division
Rohm & Haas Company

# SOLVENT TYPE COATINGS

CHAPTER 38

# ARCHITECTURAL COATINGS

## General

**38.1.1.** Graham presents data on the rate of diffusion of various solvents into dried oleoresinous varnish films and of the equilibrium swelling produced by solvents on dried linseed stand oil films. The effects of solvents on the physical properties of dried varnish films are discussed, and effects of age and temperature on brittleness is illustrated by experimental data. (JOCCA-3)

**38.1.2.** New entries in the odorless paint field underline the rising importance of "easy on the nose" paints. Odorless paints have been smaller paint-maker's answer to water-based paints. But chances are they'll eventually take over wherever consumers object to painty smells, despite cost of raw materials, and formulation problems—the chief drawbacks. Already alkyd reduction techniques have simplified paint manufacture. (CW-13)

**38.1.3.** Under the auspices of a vast European Assembly of the Chemical Arts, the 26th Congress of Industrial Chemistry and the 2nd Salon of Chemistry were held in Paris at the Park des Expositions, reports Rabate. Addresses in Section 15, representing paints, pigments, varnish and inks, gave a considerable viewpoint on the varied problems currently being investigated. These include the effect of water and aqueous solutions on paints, problems on paint thixotropy, the use of microscopes for measuring the surfaces of small particles, and measuring film thicknesses by the back-scattering radiographic method. (PM-2)

**38.1.4.** Plastic paints are becoming more popular and in this article their diverse applications are described by Gower. Writing as a decorator, the author emphasizes the importance of knowing the value and limitations of each product and points out the advantages of water-based over oil-bound types. (PM-46)

**38.1.5.** Madson & Lilley present a study on the effect of toning agents on the hiding power of white architectural enamels.

Data have been presented to show the effect of 8 toning agents on white architectural enamels.

The effect of four spreading rates and five $TiO_2$ concentrations on the shape of hiding power and apparent reflectance curves has been discussed.

Medium Chrome Yellow gave the smallest contrast ratio increase per unit decrease in apparent reflectance as measured by the multipurpose reflectometer.

Opinions regarding visual hiding power of Medium Chrome Yellow toned paints varied. Optimum eye sensitivity appears to be a major contributing factor to these differences of opinion.

The other seven colors used gave approximately equal increases in contrast ratio per unit of apparent reflectance decrease. In other words, a given apparent reflectance at a given contrast ratio is possible with any of these seven colors.

The curves will permit the selection of the required amount of $TiO_2$ per gallon to achieve a given hiding power at a given brightness level for the range covered by the eight different colors.

From a cost standpoint, Bone Black appears to be the cheapest toning agent followed by Ultramarine Blue and BON Red.

Finally, the results show that the addition of most colors increases the hiding power of the enamels—in no case did the additions cause a decrease in contrast ratio. (OD-4)

**38.1.6.** Elm discusses the mechanical properties of protective coatings films and particularly with the influence exerted by pigments. An effort is made to relate these properties to the molecular structure of the paint materials examined in the hope that a better understanding of these relationships might point the way to further advancements in the field of organic protective coatings. The mechanical properties discussed include only those which are inherent in the film and may be considered independent of the film's relationship with the substrate to which it might happen to be attached. They comprise primarily strength and distensibility.

The relationship between the strain or deformation resulting from a given stress on the coating is the stress-stain diagram. Stresses applied to coatings can be constant or they can be dynamic (stresses which increase at an arbitrary but steady rate). Factors which influence the stress-strain diagram are rate of loading, temperature, humidity, and age of specimen.

Perhaps the greatest influence upon the mechanical properties of coatings films, however, is exerted by pigmentation. As the pigment concentration increases the film loses distensibility and increases in stiffness and strength. Other factors affecting the properties of the film are particle shape, particle size, and the nature of the surface.

The aging behavior of coatings is largely dependent on changes in their plastic properties and, therefore, it is not too difficult to esti-

mat[illegible] their probable service behavior [illegible]rom their stress-strain properties (OD-5)

**38.[illegible].7.** Elm presents part I of "a [illegible]ew Look at Paint Films", the J. [illegible]. Mattiello Lecture for 1953 wh[illegible]h he delivered at the Federation of Paint & Varnish Production Cl[illegible]s Convention in Atlantic City. Fir[illegible]t printed in the Official Federation Digest. (CPVM-14)

**38.1.8.** Moore, in lecture XV in the Third Ten-Year Practical Paint Course sponsored by the New England Production Club, discusses reasons why paints do not give expected service. This lecture was illustrated with 22 slides, which are reproduced in this article, illustrating various causes of failure. (APJ-21)

**38.1.9.** Lundgren, in Lecture XVIII in the Third Ten-Year Practical Paint Course sponsored by the New England Production Club, discusses the advantages of interior design over interior decorator. To decorate is to trim, as we decorate Christmas trees or cakes. The more correct term is design and painting should be an integral part of the design of a house rather than a mere decoration. (APJ-25)

**38.1.10.** A staff report (Paint, Oil & Chem. Rev.) reviews house paints.

Part I covers:

I Introduction
II White Pigments for House Paints
  A. Primary Pigments
  B. Secondary Pigments
  C. Extender Pigments
III Tinted and Colored Pigments for House Paints
  A. Tint Base Pigments
  B. Pigments for Dark House Paints (POCR-31)

**38.1.11.** Paint, Oil and Chemical Review presents Part II of a staff report on house paints. This includes:

IV Vehicles for House Paints
  A. Linseed Oil
  B. Other Vegetable Oils
  C. Dehydrated Castor Oil
  D. Resinous Additives
  E. Tall Oil
  F. Emulsion Vehicles
  G. Alkyd Resin Vehicles

([illegible]OCR-32)

**38.1.12.** Paint, Oil and Chemical [illegible]eview presents Part III of a staff report on house paints. It includes:

I The Formulation of House Paints
  A. White House Paints
  B. Tint Bases
  C. Dark Colored House Paints
  D. Primers
  E. One Coat House Paints

(POCR-34)

**38.1.13.** Paint, Oil and Chemical Review presents Part IV of a staff report on house paints. This fourth and concluding part includes:

I The Formulation of House Paints (Concluded)
  F. House Paints Based on Alkyd Resins and other Synthetic Vehicles
  G. Emulsion Paints
  H. Miscellaneous Formulations
II Relationship of the Wooden Surface to House Paint
III Application of House Paint
IV Testing of Exterior Durability
V Preparation of House Paint
VI Summary

(POCR-35)

**38.1.14.** The American Zinc Sales Company has released their study on exterior formulation trends. 14 year study reveals validity of earlier studies—titanium zinc and "war oil ratio" resist change—DCO enters the picture—calcium pigment gains.

Full details are found in report available from American Zinc Sales Co. (POCR-36)

**38.1.15.** Elm presents part III of his paper "A New Look at Paint Films," based on the Joseph J. Mattiello Lecture delivered by the author at the Federation of Paint & Varnish Production Clubs Convention in Atlantic City in 1953. (CPVM-18)

**38.1.16.** Elm presents part III of his paper "A New Look at Paint Films" based on the Joseph J. Mattiello Lecture delivered by the author at the Federation of Paint & Varnish Production Clubs Convention in Atlantic City in 1953. (CPVM-24)

**38.1.17.** A surface coating mastic composition comprising mixture of aggregate filler material and a vehicle comprising about 25 parts by weight of vinyl acetate-vinyl chloride copolymer dissolved in about 100 parts by weight of a solvent comprising about 70 per cent by weight of a liquid aromatic hydrocarbon and about 30 per cent by weight of a ketone, and a solution containing about 1/3 water and about 2/3 of an aliphatic alcohol having less than 4 carbon atoms in an amount sufficient to cause a two-phase separation of said mixture to produce a plastic cohesive phase of such non-sticky character that it can be spread with a trowel. (USP-141)

cf: 21.1.7

### Interior Wall Paint

**38.2.1.** Emmerling, et al, compared various interior wall paints. This is a continuation of earlier work. Results indicate that improved alkyd modified latex paints are much better in sheen uniformity than the other latex paints. These materials would be at least as satisfactory for single coat work as any other materials tested in any application for which they have sufficient hiding.

The commercial alkyd flat enamels differed among themselves significantly in ease of soil removal and degree of polishing but have a much higher sum of all washability ratings.

The selection of a product will depend largely on the objectives involved and the surface to be covered. The wide selection of interior coatings now available, enables the consumer to pick the product best suited for his particular problem. (OD-10)

**38.2.2.** Stieg & Burns discuss the effect of pigmentation on modern flat wall paints. Modern flat wall paints are expected to combine high hiding, non-penetrating, suitability for tinting to deep tones & washability with the enamel holdout of a primer-sealer and do so in a single coat.

It is impossible to formulate a flat wall paint having good color uniformity unless the vehicle used is completely non-penetrating. The penetration of a paint depends on the degree of agglomeration of the polymer molecules in addition to the size of these molecules. The degree of agglomeration is influenced by the type of solvent, the weaker solvents producing larger micelles.

The penetration of the paint is also determined by its P.V.C.

Better non-penetration, enamel hold-out and color uniformity properties are obtained where the P.V.C. is below the Critical P.V.C. for the pigment.

Formulation procedures have been suggested which if followed with available pigments and vehicles, will either result in the development of highly satisfactory flat wall paints or clearly demonstrate the unsuitability of the particular materials selected. (OD-26)

**38.2.3.** The Baltimore Club presents a comparison of alkyd flat, latex, and other interior wall paints. Stability tests, application characteristics, appearance of dried film, recoating and adhesion, washability, and summary and conclusion are presented. (POCR-7)

**38.2.4.** Singer presents part I of Chapter XI in "Fundamentals of Paint, Varnish & Lacquer Technology." This chapter deals with interior architectural finishes. (APJ-52)

**38.2.5.** Singer presents part II of Chapter XI in "Fundamentals of Paint, Varnish & Lacquer Technology." This Chapter deals with interior architectural finishes. (APJ-55)

**38.2.6.** Singer presents part III of Chapter XI in "Fundamentals of Paint, Varnish & Lacquer Technology." This chapter deals with interior architectural finishes. (APJ-57)

**38.2.7.** Singer presents part IV of Chapter XI in "Fundamentals of Paint, Varnish & Lacquer Technology." This chapter deals with interior architectural finishes. (APJ-59)

**38.2.8.** Stieg & Burns discuss how pigmentation affects flat wall paints. Effects of size, effects of PVC and penetration on brightness of color, effects of various vehicles on flat wall properties, and effects of pigmentation on flat wall paint properties are discussed. (CPVM-35)

### Exterior House Paint

**38.3.1.** Vannoy reviews pigments for house paints. The following are covered: historical, primer or first coat compositions, high hiding paints, fewer coats, lead free paints, calcium carbonate as an extender and future developments. (PVP-9)

**38.3.2.** Browne discusses clear finishes for exteriors of houses. Until the last 15 years or so, varnish or other clear, unpigmented protective finish was seldom used on major exterior wood surfaces of houses that were fully exposed to the weather.

In recent years a demand has arisen for clear finishes on major exterior surfaces of houses, particularly siding, primarily due to a desire to retain the attractive red color of some woods (as redwood or red cedar) or interesting patterns of knots, etc. Natural finishes are far less durable and require a great deal more maintenance than good house paint or shingle stain. (APJ-47)

**38.3.3.** Singer presents Chapter XII of "Fundamentals of Paint, Varnish & Lacquer Technology." This chapter deals with exterior finishes for houses and buildings. (APJ-65)

cf: 23.4.1

### Fire-Retardant Coatings

**38.4.1.** In a round table discussion presented at the Federation's 31st Annual Meeting in Atlantic City, October 31, 1953, fire retardant paints were discussed.

The panel was under the Chairmanship of M. W. Westgate and panel members were A. O. Allen, G. S. Cook, R. Craig, W. Cranmer, I. Messer, B. J. Tyler, A. Van Heuckeroth and M. Van Loo. (OD-20)

**38.4.2.** A fire retardant, washable intumescent coating composition of the character described including a reacted aminoplast-aldehyde resin selected from the group consisting of urea-formaldehyde resin and melamine formaldehyde resin, an amido compound selected from the group consisting of melamine and dicyandiamide, and a carbohydrate as the active ingredients, the said active ingredients being approximately in the relative ratio of 1:2:1 respectively, and said active ingredients carried in a solvent. (USP-18)

**38.4.3.** A potentially intumescing fire retardant coating composition comprising (1) from 15 to 85% by weight of solids, said solids comprising from 50 to 90% by weight of (A) a mixture containing from 10 to 100% by weight of a film-forming condensation product of 4,4′ dihydroxy diphenyl dimethyl methane with epichlorohydrin and up to 90% by weight of a thermosetting resin selected from the group consisting of (*a*) heat-convertible phenol-formaldehyde resins, (b) heat-convertible resins of an aldehyde and a compound selected from the group consisting of urea, thiourea, guanidine, cyanamide, dicyandiamide and amino-triazines having at least two amino groups and (*c*) alkylated derivatives of the heat-convertible resins defined in (*b*), and (*B*) a water-insoluble reaction product of phosphoryl chloride and anhydrous ammonia, said last named reaction product and said mixture being present in said solids in a weight ratio of 1:1 to 1:5; and (2) from 85 to 15% by weight of an organic vehicle which includes an organic solvent for said first named condensation product and said thermosetting resin, said reaction product of phosphoryl chloride and anhydrous ammonia having a nitrogen-phosphorus atomic ratio within the range of 1.5:1 to 2.0:1. (USP-115)

**38.4.4.** 1. A paint-like flame-retarding coating composition which comprises in an aqueous medium formaldehyde, urea, in amount by weight equal to from 100% to 300% of the formaldehyde content of the composition, a member of a flame-retarding group consisting of the ammonium and zinc salts of the orthophosphates and borates in amount by weight equal to from 200% to 400% of the urea content, a thickening agent stable in 0.1% to 5.0% of the total mixture, a finely divided inert, inorganic, solid in amount by weight equal to from 50% to 150% of the urea content and hexamethylene tetramine in amount by weight equal to from 5% to 50% of the formaldehyde content of the composition.

2. The composition of claim 1 in which the thickening agent is carboxy methyl cellulose. (USP-125)

### Coatings For Masonry

**38.5.1.** Wallon outlines the characteristics of the various concrete paints and how they should be used. In the selection of a paint,

the following four criteria should be considered:

1. The degree of surface alkalinity
2. The degree of humidity
3. The results expected from the paint
4. The duration of the period during which the protection afforded by the paint is required to be effective.

(CVM-12)

**38.5.2.** Schleicher discusses the protection of masonry. Masonry is subject to leakage, efflorescence, spalling and extremes of dirt collection. Since most masonry faults can be traced to water, protection against water is the prime objective in masonry protection.

The major types of water repellents used are:

1. wax types
2. stearates
3. solvent system silicones
4. water system silicones
5. emulsion types

(PIM-17)

**38.5.3.** Schleicher presents part II of his series of articles on masonry protective finishes. In this part the author discusses resin emulsions, cement paints, natural rubber and synthetic rubber paints. (PIM-21)

CHAPTER 39

# INDUSTRIAL COATINGS

## General

**39.1.1.** Winter describes the formulation of butyl titanate paints with leafing pigments and some non-leafing pigments. The zinc dust formulation has been further improved. Butyl titanate paints have been tested as heat-resisting coatings on chimney stacks, car mufflers, locomotive fire doors and kerosene heaters, and as protective coatings for steel against corrosion by sea water. Some preliminary work on the preparation of butyl titanate anti-fouling paints is also described. (JOCCA-15)

**39.1.2.** Cowling, King & Alexander report on a study of temperature-indicating paints. Hundreds of compounds of interest to this application exist. A number of compounds are listed which when incorporated into properly working formulations will provide a series of temperature-indicating coatings covering the range from 50° to 116°C. fairly completely. (EC-8)

**39.1.3.** Nace & Walker studied the loss of drying on aging of lithographic varnishes containing alumina hydrate lakes. These studies showed that the loss increases with increasing acidity and moisture content of the pigments. It is also severe in the presence of Turkey-red oil and lakes containing excessive dye. The experimental data indicate that this loss is due to the adsorption of the cobalt onto the pigments. A cobalt adsorption test has been developed to distinguish those alumina hydrate lakes which are liable to produce loss of drying on aging. (IEC-52)

**39.1.4.** Hoenel describes a new type of baking finish wherein the solvent is water. Upon the proper addition of ammonia to the hardening and plasticizing components they became water soluble. This water solution after being applied and baked forms a hard glossy film. The coating material can be pigmented to yield colored finishes. The author feels that this type of coating material should offer many interesting possibilities which should be investigated more fully. (PVP-15)

**39.1.5.** Zuccari reports on the 31st Milan Fair. The Milan Fair inaugurated by Minister Campilli, attained exceptional importance due to large number of exhibitors and samples in an area of 390,000 square meters. Paints and materials exhibited included anti-rust paint, Araldit resins, fire-resisting paints which act as such because they are fire-resistant in themselves rather than fire-proofing the wood underneath. (PM-3)

**39.1.6.** Varron describes the mechanism whereby inks dry. The principal processes are absorption, evaporation, precipitation, solidification, filtration, gelation, oxidation, polymerization and thermal polymerization. However, although one method may predominate in the drying of one type of ink, most inks dry by a combination of processes. (PM-24)

**39.1.7.** Soane reviews aniline inks—volatile inks applied from a rubber stereo. He reviews the printing process using these materials, their formulation and the difficulties to be overcome, and methods of manufacture and testing. (PM-36)

**39.1.8.** Hopf reviews the history of printing inks for the electronic industry as applied to printed circuitry. He outlines the requirements of a suitable ink (such as be free from sulphur and chlorine, must contain only silver or silver oxide, flux and binders & solvents which completely volatilize or burn off at temperatures below 500°C) and the possible uses of the technique. (PM-47)

**39.1.9.** An investigation begun in 1951 at the Aeronautical Ma, terials Laboratory, Naval Air Experimental Station, Philadelphia Naval Base, to find the reason for the corrosion of the metal paints of helicopter blades stored in closed, painted, wooden crate showed that acidic decomposition products evolved by paints while drying cause corrosion. This was true when the paint dried by oxidation or polymerization while the short-drying lacquer type coatings did not cause this corrosion. (C-1)

**39.1.10.** In many industries, the problem often arises of effectively painting and rust-proofing metal apparatus and structures under conditions of high humidity. Many suggestions have been made as to materials and methods in such cases.

A report of German work in this field reviews the use of emulsions & use of oil paints. Also included are water-soluble components, water-binding pigments, and water-binding varnish compositions. (PM-54)

**39.1.11.** Kienle & Maresh discuss some observations on optical properties of pigmented films. Color is a primary property of protective coating films, attained by the introduction of pigments or dyes into the vehicles used to form the films. The color of a pigmented film may vary according to the character of the light and the angle at which it is viewed.

Color is attained through selective scattering, selective absorption, or interference of light. The protective coatings industry attains color mainly through the use of light scattering or absorption phenomena or a combination thereof. The optical properties of pigmented films are combinations of body color and surface reflectance phenomena.

Body color of pigmented films, such as hue, chroma, masstone, tinting strength, and hiding power are dependent largely on the theories of physical optics. Factors influencing body color are chemical constitution, crystal form, particle shape, particle size, and dispersion of pigments. (OD-21)

**39.1.12.** Marling presents recommended finish formulations and application procedures for eight major classes of industrial products. These include finishing systems for:

1) Automobiles & Trucks
2) Air Compressors, Construction Equipment, Cranes, Hoists, and Fork Lift Trucks
3) Farm Equipment, Packaging Machinery, and Hardware
4) Machine Tools and Castings
5) Refrigerators, Vacuum Cleaners, and Other Household Appliances
6) Office Equipment and Furniture, Business Machines, Printing Presses, Recorders, Photographic Equipment TV and Radio Cabinets, Cash Registers, Food Mixers, Fans, and Similar Products
7) Stoves, Furnaces, Motors, Laboratory Ovens, Exhaust Pipes, Brake Drums, Motor Housings, Motor Cycle Cylinders, Sun Lamps, Radiator Covers, Gasoline Pumps
8) Chemical Equipment, Hydraulic Pumps, Oil Drilling Equipment, Textile Machinery, Dispensing Machines, Oil Tanks, Marine Winches, Refinery Equipment, Gasoline Pumps, Welding Equipment.

PE-3)

**39.1.13.** Starr discusses finishes using leather as an ingredient. Considerable interest has recently been focused on a process whereby leather dust (scrap from buffing or sanding leather) can be used at a relatively low cost to produce leather-type finishes having all the desirable adhesive qualities of organic coatings. (OF-29)

**39.1.14.** Ames reviews the progress in organic finishes during 1948-1953. In the last five years, a number of conditions—some transient, some permanent—have arisen, which have placed new demands on manufacturers of wood, metal and plastic products. A number of these are cited, as for instance:

a. shortage of copper, brass, nickel and chromium for civilian use—created by Korean War.
b. continuing trends in industry —as applications of coatings inair craft industry create new problems
c. radar installations and other electronic equipment used by the Armed Services frequently require protection against fungus growth. A glance at the future reveals more problems to solve. (IF-6)

**39.1.15.** Fuller discusses ten years of progress in industrial finishes. He reviews better furniture finishes, improvement of catalyzed synthetic varnish, metal loatings, better hiding and longer casting colors without bleeding, new types of resinous binders or vehicles, new resistant enamels, fast drying durability, acrylic and silicone resins, epoxy resins, durable baked coatings, hammered metal finishes, coatings for molded plastics, and new additions make more materials controllable. (IF-7)

**39.1.16.** Glaser presents lecture XII in the Third Ten-Year Practical Paint Course" sponsored by the New England Production Club, on "Industrial Finishes—Present Status and Future Prospects." Industrial finishes are traced back to the pitch used for waterproofing ships in Asia Minor as early as 4000 B.C. Question and Answer period followed the lecture. (APJ-5)

**39.1.17.** Wiesel presents lecture XIII in the Third Ten-Year Practical Paint Course, sponsored by the New England Production Club, on "Modern Lacquer in our Economy." A lacquer is defined as a coating composition which dries primarily through evaporation as compared to the drying by oxidation of varnishes and synthetic coatings. (APJ-7)

**39.1.18.** Singer presents part I of Chapter X of Fundamentals of Paint, Varnish and Lacquer Technology. This chapter discusses the clear oleoresinous finish. (APJ-35)

**39.1.19.** Singer presents part II of Chapter X of "Fundamentals of Paint, Varnish and Lacquer Technology". This chapter discusses the clear oleoresinous finish. (APJ-43)

**39.1.20.** Singer presents part III of Chapter X of "Fundamentals of Paint, Varnish and Lacquer Technology". This chapter discusses the clear oleoresinous finish. (APJ-44)

**39.1.21.** Miller reviews clear and pigmented lacquers. This first part reviews cellulose nitrate, ethyl cellulose, cellulose acetate, cellulose acetate butyrate, vinyls, acrylics, soluble nylon, polyamide resins, corn protein, parlon, styrene-butadiene resins, styrenated alkyds (and other alkyd copolymers), emulsion coatings, polystyrene, fluorinated resin (Exon 400-XR-61), and allylstarch. (POCR-28)

**39.1.22.** Miller reviews clear and pigmented lacquers. This second part reviews pigmentation, solvents—changes due to methods of application, wood finishes, nonyellowing lacquers, hot spray lacquers, automotive lacquers, metal lacquers, paper coatings, latex type coatings, textile printing lacquers, electrical cable coatings, heat resistant lacquers, multicolor lacquers, aerosol lacquers, stripping lacquers and conclusions, 24 references cited. (POCR-29)

**39.1.23.** Moore reviews industrial finishes. Industrial finishes can be classified under one of the following groups: (1) crystallizing finishes, (2) crackle lacquers, (3) hammer finishes, (4) wrinkle finishes, and (5) spatter finishes.

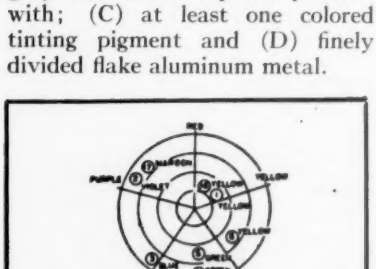
The author discusses curing of hammer finishes, curing of wrinkle finishes, ingredients and manufacture of wrinkle finishes, and desirable characteristics in wrinkles. An extensive bibliography is included. (APJ-68)

**39.1.24.** The first of two parts of a paper in the series "Technology of the Paint, Varnish and Lacquer Industry" covers cellulosic and chlorinated rubber lacquers. This series of papers was presented at the 1953-1954 Technology Course of the Toronto Paint & Varnish Production Club. (CPVM-26)

**39.1.25.** Wirt presents part II of "What you should know about cellulosic and chlorinated rubber lacquers." This series of papers was presented at the 1953-54 Technology Course of the Toronto Paint & Varnish Production Club. (CPVM-30)

**39.1.26.** A coating composition adapted to yield a tough, durable finish having a metallic appearance of great depth and brilliance comprising a vehicle and pigment, the said pigment consisting of a prime pigment selected from material of the group consisting of colloidal hydrous iron oxide and chromium tetrahydroxide; B *transparent* pigment substantially complementary in color to the said prime pigment in amount to yield a gray when mixed separately therewith; C at least one colored tinting pigment and D finely divided flake aluminum metal. (USP-1)

**39.1.27.** A coating composition adapted to yield a tough, durable finish having a metallic appearance of great depth and brilliance, comprising a vehicle and pigment, said pigment consisting of (A) the nickel complex of the azo dye obtained by coupling diazotized parachloraniline with 2,4-dihydroxyquinoline; (B) pigment substantially complementary in color to the said (A) pigment in amount to yield a gray when mixed separately therewith; (C) at least one colored tinting pigment and (D) finely divided flake aluminum metal.



(USP-2)

**39.1.28.** A lacquer composition comprising a resinous ingredient, and oxidation inhibitor capable of terminating the oxidation of said resinous ingredient when exposed to atmospheric oxygen, and a solvent for said resinous and inhibitor ingredients, said resinous ingredient comprising the product formed by oxidation of a mixture of unsaturated conjunct polymer hydrocarbons recovered from an acid-acting catalyst-hydrocarbon complex formed in the catalytic conjunct polymerization of hydrocarbons and consisting of polyolefinic, cyclic hydrocarbons boiling in the range of from about 150° to about 450° C. and having bromine numbers above about 140 and maleic anhydride values of from about 30 to about 90 and containing from about 2.5 to about 4 double bonds per molecule of which from about 40 to about 70% are in conjugated relationship to each other. (USP-17)

**39.1.29.** The method of making a protective coating material which comprises heating from 65% to 40% of a China-wood oil and from 35% to 60% of polyterpene resin to a temperature between 230° C. and 245° C. to form a varnish; thinning said varnish with a suitable solvent; and thereafter mixing from 35% to 85% of said thinned varnish, based on the non-volatile weight, with a material comprising from 20% to 90% mica and the balance titanium dioxide. (USP-23)

**39.1.30.** A liquid coating composition for application to the surfaces of plastic materials, said composition being characterized by the fact that it becomes bonded to plastic materials without heat and pressure and is resistant to molding treatment, including heat, said composition comprising the following materials in substantially the proportions indicated: 20 pounds pigment, 2½ fluid ounces wetting agent, 3½ to 6 gallons acrylic resin, 50 fluid ounces dibutyl oxalate and 80 fluid ounces to 1 gallon butyl lactate, said resin being selected from the group consisting of polymerized methylacrylate and polymethyl-methacrylate. (USP-28)

**39.1.31.** In the application of coatings of solutions in water of at least 2% concentration of protein having a pH at which the protein will remain in solution at room temperature which protein solutions contain therein in suspension silver halide particles, to a support therefor, the method of quick setting those coatings which comprises incorporating in the protein solution containing the silver halide in suspension therein ¼-50% (based on the weight of the protein) of an aldehyde selected from the group consisting of formaldehyde, glyoxal and acrolein, coating out the protein composition in fluid form onto the support and fuming the coating with gaseous ammonia whereby rapid setting of the coating is obtained without chilling thereof being necessary. (USP-30)

**39.1.32.** Process which comprises applying a cellulose nitrate undercoating to the surface of an article, coating said article with a gel lacquer comprising from about 15 to 40 parts by weight of cellulose propionate in about 100 parts by weight of a solvent mixture in which the solvents consist of from about 50 to 10% by weight of a material of the group consisting of propyl acetate, isopropyl acetate, butyl acetate and amyl acetate and from about 50 to 90% by weight of a material of the group consisting of xylol and toluol, and gelling the coating so produced by reducing its temperature below the gelation temperature. (USP-31)

**39.1.33.** A process of coating a water insoluble, water repellent coating upon the surface of a base material, comprising, applying an aqueous solution of a water soluble salt of an acid selected from the group consisting of starch ether carboxylic acid and starch ester carboxylic acid to said surface of said base and thereafter coating the so treated base with an aqueous solution of a polyvalent metal salt selected from the group consisting of water soluble salts of aluminum, ferric iron, chromic chromium, and tin, and forming a water insoluble salt with the acid applied in the first coating, said metal salt solution having emulsified therein a water repellent paraffin material. (USP-48)

**39.1.34.** A coating composition comprising a drying vehicle and an effective amount up to about 2 per cent by weight of metal, based on the weight of the drying vehicle solids, of a drier comprising a polyvalent drier metal salt of the monoalkylesters of diisobutenyl-

succinic acid and triisobutenylsuccinic acid, wherein the alkyl group contains from 1 to 4 carbon atoms, inclusive. (USP-54)

**39.1.35.** A polychromatic coating composition comprising an organic film-forming material, a colored pigment, and an aluminum flake pigment, said aluminum flake pigment constituting not more than 90% of the total pigment and having a covering area between 14,500 and 17,000 square centimeters per gram of flakes, not more than 20% of said covering area being contributed by flakes having a maximum dimension less than 5 microns and not more than 5% of said covering area being contributed by flakes having a maximum dimension greater than 25 microns. (USP-65)

**39.1.36.** A fluid resin dispersion, capable of being spread upon a surface and thereafter fused by heating into a hard, stable, continuous, tough and abrasion-resistant coating, comprising resin, plasticizer and diluent, said resin, plasticizer and diluent consisting of (1) solid thermoplastic polyvinyl resin having an average molecular weight in excess of 45,000 and made from vinyl chloride in major amount, (2) plasticizer for the said resin, and (3) diluent selected from the group consisting of the alkyl ethers of mono and diethylene glycol in which the alkyl radical possesses at least 4 but no more than 10 carbon atoms and having a boiling point above at least 205° C., in which the combined weight of the said plasticizer and diluent is from 33 to 40 per cent of the combined weight of said resin, plasticizer and diluent, and wherein the weight of said diluent is 15 to 85 per cent of the combined weight of said diluent and plasticizer. (USP-87)

**39.1.37.** A coating composition comprising 100 parts of an oily siccative diolefin polymer prepared by the polymerization of conjugated diolefins having from 4 to 6 carbon atoms in the presence of a catalyst chosen from the class consisting of hydrocarbon soluble peroxides and metallic sodium having a molecular weight between 1,000 and 10,000 in solution in a hydrocarbon solvent boiling between about 60 and 250° C., 5 to 300 parts of a finely divided pigment dispersed therein, a small amount of at least one heavy metal soap drier, and about 2.5 to 10 percent of powdered calcium oxide based on the weight of diolefin polymer. (USP-93)

**39.1.38.** A liquid coating composition capable of providing a smooth metallic surface on drying and burnishing comprising in admixture a synthetic resin consisting of a tripolymer of vinyl chloride, vinyl acetate and maleic acid; finely divided, unpolished aluminum powder consisting of particles of aluminum coming within the size range from about 1 micron to about 44 microns; an aliphatic ketone base solvent for the resin and a relatively small amount of propylene oxide. (USP-113)

**39.1.39.** A coating composition comprising a paraffin wax and a completely esterified styrene-maleic anhydride heteropolymer made by reacting the heteropolymer with a mixture of alcohols obtained by hydrogenation of coconut oil, said wax being present to the extent of from 70 to 99.90 per cent by weight of the total weight of the wax and the esterified styrene-maleic anhydride heteropolymer. (USP-118)

**39.1.40.** Process for the production of waterproof products which comprises mixing a liquid polymer of an organo silicone wherein each organo group is a methyl radical with silicon dioxide, the latter being in the form of an empalpable powder and forming at least 25% by weight of the mixture, storing the mixture for a period of at least one week at room temperature and thereafter working the mixture until it is converted at least to the consistency of a smooth paste. (USP-123)

**39.1.41.** A cement waterproofing composition comprising a 1 to 10 compatible, cold-blendable mixture of non-interacted ingredients comprising (1) an organopolysiloxane resin in which the organic groups are selected from the class consisting of methyl, ethyl, phenyl radicals, and mixtures of such radicals attached to silicon by carbon-silicon linkages and obtained by hydrolyzing an organochlorosilane designed to give the above-mentioned organopolysiloxane with a mixture of ingredients consisting essentially of (*a*) water and (*b*) a liquid chlorinated hydrocarbon which is a solvent for both the organochlorosilane and the formed organopolysiloxane, said solvent having a specific gravity above 1.1 and a boiling point below 175° C. and being inert to any formed hydrogen chloride, to the aforesaid organochlorosilane an to the organopolysiloxane, and (2) an oil-modified alkyd resin, the said organopolysiloxane resin comprising, by weight, from 10 to 50 per cent of the total weight of the latter and the oil-modified alkyd resin. (USP-126)

**39.1.42.** A coating composition of improved stability that forms water-repellent coatings of superior permanency, comprising a siloxanol whose molecules consist of silicon atoms to which are attached (1) OH groups, (2) oxygen linkages connecting silicon atoms, and (3) secondary amyl radicals, any additional radicals attached to the silicon atoms being (4) primary alkyl radicals having from one to six carbon atoms, the average number of the radicals (4) attached to each silicon atom being from 0 to 0.9, the average number of the radicals (3) attached to each silicon atom being from 0.3 to 0.75, the average total number of the radicals (3) and (4) attached to each silicon atom being not greater than 1.2, and not less than 30 per cent of said silicon atoms having the radicals (3) attached thereto. (USP-127)

**39.1.43.** A composition for forming temporary strippable protective coatings on finished surfaces, comprising a plasticized polyvinyl butyral dispersed in water containing as dispersing agents mahogany sulfonates corresponding to the formula $C_nH_{2n-10}SO_3Na$, wherein $n$ is in the range of 20-30 and the average molecular weight is in the range of 400-600, said composition having a substantially neutral reaction and containing 2-16.5 parts of a stripping agent selected from the group consisting of soya lecithin and solid polyoxyethylene glycol, for 100 parts of the polyvinyl butyral. (USP-133)

**39.1.44.** The method of preparing coating compositions which comprises mixing together an aqueous solution of a water-soluble organic dye, and aqueous dispersions of a drying oil and dewaxed shellac, adding an electrolyte to

break the dispersions and transfer the dye and dispersed materials from the water to the oil phase, separating the water and drying the oil phase. (USP-135)

**39.1.45.** A coating composition comprising an organic film-forming material, which dries to a tough, durable, water-resistant film, and a pigment consisting of colloidal nickelous hydroxide, said nickelous hydroxide having been retained in a gelatinous water-wet state during the entire period between its formation and its incorporation in the said coating composition. (USP-151)

**39.1.46.** An aerosol lacquer of the pressure-generating solvent type containing 20-30% lacquer and a complement of a pressure-generating solvent consisting of about 50% dichlorodifluoromethane and a complement of 1,1,1-trichloromonofluoroethane, said lacquer consisting of 10-25% solids and a complement of lacquer solvent, said solids consisting of about 50% ethyl cellulose having a D. S. in the range of 2.5-2.6 and a complement of ethyl cellulose compatible plasticizing resins, and said lacquer solvent consisting of about 80% xylene and about 20% isopropyl alcohol. (USP-154)

**39.1.47.** Sherwin-Williams introduced Opal-Glo, a new approach in use of aluminum powder and colored pigments to give illusion of depth. A special technique is necessary. Its brush applied, then rolled to smooth it and to orient the metal flakes. Instead of seeking to get the metal particles to lie flat and give a plating-like effect, Opal-Glo keeps them on edge. The result is a certain degree of internal reflection that gives the effect of depth.

cf: 5.2.1
21.1.4
21.1.8
42.1.11
46.2.6

### Primers And Sealers

**39.2.1.** Rosenbloom presents data that help construct a picture of the reactions that occur between wash primer constituents. Oxidation plays a dominant part. Chromate derived from the pigment is soluble in the alcoholic phosphoric acid solvent and is the source of the oxidizing power of the composition. Phosphoric acid reacts with polyvinyl butyral but only under the influence of the reduction of chromium. (IEC-22)

**39.2.2.** Rigg & Skerrey report on 3½ years exposure of eight alloy specimens in rural, industrial and marine atmospheres, with various primers under aluminum topcoats. The results confirmed earlier indications. Zinc chromate and zinc tetroxychromate primers were superior in protective value to iron oxide primer, although the latter provided satisfactory protection, especially to aluminum in the less severe environments. Red lead primer was definitely harmful on light alloys, and especially on magnesium in corrosive environments. In these tests both types of chromate primer were found to be slightly preferable to red lead on mild steel. Zinc chromate and zinc tetroxychromate pigments are preferred for primers for composite structures of steel and light alloys in severe exposure conditions, while iron oxide is adequate for milder conditions. (PM-34)

**39.2.3.** Testro discusses primer failures on exterior woodwork. From a purely adhesion standpoint the absorptive nature of wood would seem to make it an ideal receptive surface for painting systems. This article outlines some of the reasons for the failure of primers. Moisture in the wood is one of the prime factors affecting failure-some moisture is necessary in the wood as excessive dryness leads to failure as does excessive moisture in the wood. Other factors include differences in grain structure, sea salt contamination in some woods, non-uniformness in the expansion and contraction of wood in different direction, resinous content of the wood, and extraneous matter on the surface of the wood. (PM-44)

**39.2.4.** Results of tests on pretreatment primers is presented. The primers referred to are based on polyvinyl butyral as the film-forming resin and a particular form of yellow zinc chromate, zinc tetrahydroxy chromate, as the pigment. The solvent carrier consists of a blended mixture of solvents (mainly alcohols) containing a specified quantity of water and phosphoric acid. The performance of these etch primers under hot damp conditions is established as very good. (PF-8)

**39.2.5.** Danforth, et al, discuss the protectometer and the evaluation of anti-corrosive primers. Three classes of methods are used for evaluating metal protective coatings:

1. preliminary or screening tests
2. panel exposure tests
3. field tests.

The salt spray test is one form of laboratory test which can be used for preliminary or screening testing. The use of the protectometer utilizing an electrochemical technique eliminates the human element in evaluating salt spray tests. Wiring and external circuit diagrams are presented. (POCR-5)

**39.2.6.** An aqueous softening and sizing medium suitable for application to gel films of regenerated cellulose, said medium comprising 5% glycerol, 0.1% colloidal silica, and 0.1% of a condensate of stearic acid with ethylene oxide containing 50 ethylene oxide units per molecule. (USP-56)

**39.2.7.** As a coating composition for wood, a solution-suspension containing the following constituents by weight: 372 parts butanol; 685 parts of a mixture consisting of 50% refined shellac and 50% alcohol; 30 parts of a mixture comprising 50% manila gum and 50% butanol; 2100 parts silica; and 870 parts talc. (USP-108)

**39.2.8.** A storage-stable dry rosin size consisting essentially of the dry saponification product of rosin remaining after the removal of the fatty acids from tall oil by fractional distillation, said size containing about 0.5-2% of phenothiazine and about 0.2-2% of a diaryl-amine based on the weight of said rosin. (USP-132)

**39.2.9.** The Lead Industries Association has issued Red Lead Technical Letter #8: Primers for Railroad Structures and Rolling Stock.

cf: 39.3.4
50.4.1

### Metal-Protective Coatings

**39.3.1.** Slabaugh & Grotheer present a theory for the mechanism of filiform or underfilm corrosion. Observations show that filiform corrosion is an electrochemical process. The actual electropotential that exists between anodic and

cathodic areas was measured, and the identity of these areas was established. An osmotic phenomenon probably accompanies the electrochemical reactions. The growing head of the rust filament is a tiny corrosion cell that contains an anolyte of approximately 40% solids. The electrolyte in this cell originates in the corrosion reactions and in the diffusion of moisture through the film, where small quantities of soluble components are eluted.

The proposed theory provides a point of departure for the development of suitable means of controlling filiform corrosion. (IEC-55)

**39.3.2.** Recent German investigations into accelerated testing of anti-corrosive paints included the three different periods or stages in the life of an anti-rust paint film-pre-aging, properly aged, and decline. It was concluded that the accelerated test suffers two defects a) only the present, maybe temporary predominant factors are studied; b) artificial media and methods are often too vigorous. (PM-28)

**39.3.3.** Stauffacher & Davidson report on field tests of exterior coatings for a pipe line conveying fuel oil heated to 200°F. Four different coatings were tested-asphalt wrap with average total thickness of 0.250 inches, coal-tar wrap with average total thickness of 0.250 inches, coal-tar wrap with average total thickness of 0.156 inches and asphalt mastic with average total thickness of 0.500 inches. Due to its ruggedness and freedom from distortion during the test, it was decided to recommend a ½ inch thick asphalt mastic coating using a 250°F melting point asphalt for the hot-oil pipe line exterior coating. (C-2)

**39.3.4.** Danforth, et al, discuss the protectometer and the evaluation of anti-corrosive primers. There are three classes of methods used for the evaluation of metal protective coatings: 1) Preliminary or screening tests, 2) Panel exposure tests, and 3) Field tests. Group one tests can be conducted in the laboratory and are used to eliminate poor coatings and consequently reduce the number of exposure panels. Accelerated weathering, salt spray, water permeability, and water condensation are examples of this type of test.

The authors feel justified to conclude that the life of an anti-corrosive primer coat can be predicted from its behavior in the saltspray cabinet and the determination of the electrical resistance of the paint film at various intervals.

In the cases studies, the composition of the vehicle influenced the protective abilities of the paint, even at relatively thick coats of 4 mils thickness. The influence of the pigment volume concentration upon the resistance to corrosion proved to be pronounced if relatively thin coats (2 mils) were studied. The thickness of the coating is important in that much greater protection was provided by a film of 5 mils than by one of 3 and 1 mil thickness, respectively. (OD-15)

**39.3.5.** The use of the roller-coating machine to lacquer metal sheets, the conversion of the sheet into cans, and the different lacquers required for various purposes were recently described in a lecture to the Organic Finishing Group of the Institute of Metal Finishing by T. G. Green. Lacquering or decorating the outside is used to make the package pleasing in appearance and lacquering the inside prevents chemical action between the can and the contents. Thus the coating protects the metal against attack from contents by products of such action. (PM-38)

**39.3.6.** "The Protection of Ferrous Metals" was the title of an exhibition, the first of its type in the United Kingdom, organized recently by the Corrosion Group of the Society of Chemical Industry at Battersea Polytechnic, London. Of the four main methods of controlling corrosion, the use of protective coatings is by far the most important. (PM-39)

**39.3.7.** A number of papers, presented at the Fourth International Conference on Electrodeposition and Metal Finishing held in London recently, dealt with organic finishes for metals. These papers included Automobile Organic Finishing, Infra-red Stoving for Paint Finishes, A New Type of Primer for Resistance Welding, and Finishes on Electroplated Coatings. (PM-53)

**39.3.8.** Before the beginning of the 20th Century, most water-treatment equipment was constructed of masonry and hence was not excessively subject to corrosion. Modern water treatment requires the use of corrosive chemicals and equipment has been fabricated more and more of ferrous alloys which are subject to corrosion. Therefore a considerable corrosion problem is presented in many phases of water treatment, both in the prevention of the destruction of equipment and in the prevention of contamination of the water. Smith discusses some of the types of water treatments which are employed today and the corrosion prevention measures which are taken. (OF-5)

**39.3.9.** Smith presents the second part of his discussion of protective coatings and linings for water treating equipment. In this last part he covers: coatings for degasifier units, coatings used for filtration and coagulation equipment, coatings for chemical feeding equipment, and other applications for protective coatings in water technology. (OF-12)

**39.3.10.** Hedlund reviews recent developments in silicone vehicles for maintenance paints. Silicone resins have won wide recognition as vehicles for heat-stable and corrosion-resistant paints. Use of these finishes has been pretty much confined to heat-resistant applications, and their full value could not be realized on ordinary installations which could not be heated.

Certain new resins have been developed which show definite promise. These include silicone-alkyd resins and vehicles. (OF-13)

**39.3.11.** Larson discusses the development and use of polyvinyl butyral wash primers to control corrosion of metals. The metal conditioner or wash primer principle assures a better foundation for paint systems while preventing underfilm corrosion. Direct economies result from less frequent shutdowns for repairs and replacements in marine, industrial and maintenance fields. (OD-63)

**39.3.12.** Rabate & Rabate discuss the maintenance painting of the Eiffel Tower. The most widely used paint has been a linseed oil

paint based on micaceous iron oxide. (OD-64)

**39.3.13.** Grupp reviews the contents of the recently declassified Naval Research Laboratory's third report on experiments with anti-corrosive coatings for magnesium. A copy of the report is available from the Photoduplication Section, Library of Congress, Washington 25, D. C. (OF-22)

**39.3.14.** Stewart discusses impermeable organic coatings. The ideal corrosion resistant coating is one that, even though in a single layer, would not allow either liquid or gas to be transmitted by or penetrate through its film. Almost perfect impermeability can be obtained with a plurality of coatings. (OF-24)

**39.3.15.** There are a number of reasons for applying an organic finish over electroplated surfaces. It affords outstanding contrast, as in name plates, it satisfies electrical requirements where electrical contrast has to be made to the base metal, and it utilizes raw material which is supplied in the electroplated condition. Organic finishes may be applied to almost every kind of electroplate, however zinc and cadmium offer the greatest practical difficulties. The organic finishes employed may be lacquer, enamel, paint or varnish, but the technical problems involved are much the same in each case. (OF-42)

**39.3.16.** After briefly mentioning the theory of metallic corrosion, Volkening relates the problems encountered by Dow in protecting its Gulf Coast plants against atmospheric corrosion. Examples of coating successes and failures are given. The method which Dow uses of testing paint cooperatively with the manufacturer is explained. The author points to advantages of proper surface preparation and suggests too little attention is paid to educating the 350,000 painters who apply coatings to metals in proper application techniques and that paint manufacturers, paint manufacturer's associations and the National Association of Corrosion Engineers might find the organization of schools for painters a worthwhile activity. (C-5)

**39.3.17.** The principles applying to the formulation of organic coatings are given and the effects of vehicle, pigments, and thinners are discussed. Special problems applicable to the preparation and application of plastic coatings are discussed with particular reference to their adhesion, solubility, and pigment dispersion characteristics. Plastic prefabricated liners, liquid coatings, dispersion resins, hot melt techniques and mastics are covered. The mechanism by which coatings retard corrosion are listed and the relative value of barrier and polarizing coatings mentioned. Coatings suitable for severely corrosive environments are considered and the special qualities of coatings suitable for use underground are listed. The questions of adhesion, permeability, surface preparation and chemical stability are correlated for coatings suitable for underground pipe or marine vessels. (C-6)

**39.3.18.** Greenblatt discusses sea water immersion trials of protective coatings. Trials of a variety of types of underwater compositions have shown the superior performance of vinyl finishes, both as protective and antifouling paints. Panel tests have shown that vinyl finishes can be used on cathodically protective hulls and shipboard trials have substantiated this, provided that a controlled cathodic protection system is used. (C-7)

**39.3.19.** Seymour believes liquid neoprene, among the coatings commercially available today, appears to be closest to the ideal coating. The characteristics of several compositions of neoprene are given, application and curing techniques discussed, resistance to certain chemicals itemized and conformity with military and industrial standards compared.

Superiority of Type KNR over certain other compounds of neoprene is discussed and explained. The author recommends on-the-job compounds as superior to one-part compounds. Specifications for various kinds of neoprene formulations are given, together with an explanation of fillers, applications and compounding techniques.

Numerous case histories of successful application of neoprene to protect plant against various corrosive environments are listed. (C-8)

**39.3.20.** Grove describes procedures and results of coating internally several miles of old aluminum, steel and new steel pipe. The method involves scraping corrosion products from inside old pipes, descaling and drying. Coating is applied when two plugs between which coating has been poured are moved through the pipe by air pressure. Drying by air injection or aspiration follows. Economics of the lining operation are reported to be good although perfect results were not obtained with badly corroded steel pipe. Adhesion of the coating is the critical problem, even small amounts of water being conducive to separation. Coating of new steel lines is facilitated by proper design. Rigid inspection at every phase of the cleaning, drying and coating operation is recommended, at least 5 mils thickness is recommended, this to be obtained by multiple coats, if necessary. When dessicants are used in drying operation some means of determining when the dessicant is saturated should be employed. Better cleaning is needed, especially to remove sulfides. (C-9)

**39.3.21.** Alkaline and hygroscopic welding flux byproducts deposited on weld seam and adjacent areas frequently are the cause of early failure of coatings on welds. Close observation, by Liebman, indicates many paint failures previously believed to have resulted from residual stresses in weld areas can be attributed to the effects of weld heat oxides, weld flux, spatter and weld flux fume deposits.

Extra thick vinyl pretreatment coatings followed by a mastic and finish coat are helpful in prolonging protection given metal from the environment when flux deposits are inadequately removed. (C-10)

**39.3.22.** Data received in reply to a questionnaire is compiled on the actual field practices of utilities operating pipe-type cables. The data cover more than 90 percent of this type of cable in operation at the time the survey was made. The principle data are tabulated, giving reports by seventeen operators on field practices. The subjects covered include size and kind of pipe, coating materials, holiday testing, potential surveys, cathodic protection, coating resistance mea-

surements, rates of coating resistance depreciation, bonding, stray current measurements, shunts, surveys, voltages and magnitudes of cathodic protection currents and other information. (C-13)

**39.3.23.** Blackmore discusses the use of protective coatings as the first line of defense against corrosion. Included are theory of corrosion, air conditions offer a special challenge, two ways to combat corrosion, why use a primer, discussion of adhesion, the importance of adequate care, and other functions of coatings. (IR-8)

**39.3.24.** Farber discusses a new epoxy primer having high resistance to alkalies. Its superiority over an alkyd primer is illustrated. A new flow coating technique combined with this new primer permits thinner film thickness and improves corrosion resistance three times. (MM-3)

**39.3.25.** Benn discusses the use of asphalt coatings—solvent and emulsion—for metal protection. Advantages are low initial cost of application and extremely long life of the material. Disadvantages is color which is offset to some extent by use of an asphalt-aluminum paint. (MM-5)

**39.3.26.** Marsh describes the use of organic finishes on electroplated surfaces. The most important reason for using the combination of electroplate and organic finish is to provide better resistance to corrosion than would be afforded by either finish when used alone. Other reasons for the choice of dual coatings are:

1. to give improved adhesion to the organic coating; for example, nickel on brass and phosphor bronze
2. to provide electrical insulation (enamel on electroplated cable supports)
3. to afford outstanding contrast, as in various types of name plates
4. to satisfy electrical requirements
5. to utilize raw material which is supplied in the electroplated condition (zinc coated steel sheet).

Some form of "chemical treatment" for electroplated coatings is desirable if the best characteristics of adhesion are to be developed on organic applied coatings. It is a must for zinc, cadmium, copper and chromium and advantageous for nickel, tin, silver and gold. For zinc and cadmium, practical processes in ascending order of merit are chromating, phosphatizing, tin plating and etch priming; and for the other metallic coatings, etch priming is the most effective treatment. (PF-13)

**39.3.27.** Van Loo, et al, discuss filiform corrosion. Filiform corrosion is a thread-like type of corrosion which develops under protective coatings on certain metals, usually in humid atmospheres. It has directional growth and definite structure. Controlling factors are the physical nature of the coating and the exposure conditions. The tracks do not cross each other but deflect or join in a predictable manner. A theoretical explanation is offered involving a driving force and a directing force. The driving force is the diffusion of the corrosive atmosphere into the active head resulting in further metallic corrosion. The directing force is explained on the basis of concentration cells. (POCR-12)

**39.3.28.** Pierce discusses two good reasons for going to thick protective coatings. Under 5 mils thickness, failure of equipment will be rapid regardless of coating type—due to poor coverage over hard-to-coat areas. Above 5 mils, coating performance can be controlled—and it depends primarily on resistance to the environment of the coating selected. (CE-15)

**39.3.29.** Liebman discusses corrosion resistant finishes. Finishes to protect metal against corrosive agents have been used by industry with more or less success for over one century. There is no paint formulation which would suit every possible situation and environment.

The author lists 19 characteristics of paints, and 14 methods of control. (APJ-66)

**39.3.30.** Thiede discusses corrosion prevention and control. No single paint will answer every purpose and for general painting purposes under the conditions present at the Grasselli, N. J. plant of General Aniline Works Division of General Aniline and Film Corp., a paint blended of oil and phenolic vehicles gives longer service life than straight applications of either the oil or phenolic types. (PIM-8)

**39.3.31.** Schleicher presents part II of his paper on protection of steel. This part covers the subject of primer coats and includes vehicles and pigments with discussions on red lead and blue lead. (PIM-27)

**39.3.32.** Honnaker reviews corrosion control and prevention. Types of corrosion are discussed. Plastics and elastomers, rubber-lining compounds, and protective coatings for control and prevention of corrosion are discussed. (PIM-28)

**39.3.33.** The method of forming an improved corrosion-resistant paint which comprises mixing turpentine and anhydrous antimony chloride, with the amount of antimony chloride being from 30% to about 50% by weight of the mixture, until an oily material containing an antimony compound is formed, adding water to the oily material containing said antimony compound, thereby forming a water-insoluble, colloid-like dispersion of an antimony compound in the oily material, and adding a neutralizing agent to the dispersion in order to neutralize any free acid. (USP-46)

**39.3.34.** An improved composition of matter for use as a protective coating for oxidizable metals consisting substantially of 2½% to 35% by weight sodium meta borate, up to 40% by weight plastic clay, and 15% to 90% by weight of an inorganic material of reduced valence, termed an oxidation inhibitor incapable of reacting with the said borate selected from the group consisting of graphite, carbon black, iron and copper, said percentage of sodium meta borate being based on the weight of the anhydrous salt. (USP-55)

**39.3.35.** A composition adapted for use as a rust-inhibiting coating for metals, comprising a substantially non-corrosive vehicle in major amount based on the weight of said composition, and a small amount, sufficient to impart rust-inhibiting characteristics to said composition, of a hydrocarbon acid phosphate salt of an alkylol-containing amine having an alkylol group esterified with a hydrocarbon sulfonic acid. (USP-75)

**39.3.36.** In a method of protecting metallic objects from corrosion, the steps of: applying to the sur-

face to be protected a coating composed essentially of an aqueous solution of alkali silicate and finely divided metallic zinc, the zinc constituting between about 75% and 96% of the mixture on a dry basis, and treating said coating with a dilute aqueous saline solution having a pH of between 4 and 8.5 to produce a complex zinc-alkalisilicate in situ. (USP-106)

**39.3.37.** An anti-corrosion coating composition comprising 100 to 102 parts of a copolymer of vinyl chloride, vinyl acetate and maleic acid wherein the vinyl chloride forms 86%, the vinyl acetate 13%, and the maleic acid 1% of the copolymer, 40 to 42 parts of a methacrylate polymer selected from the group consisting of n-butyl methacrylate polymer, isobutyl methacrylate polymer and n-propyl methacrylate polymer, 33 to 35 parts of a plasticizing material selected from the group consisting of the polyethylene glycol-di-2-ethylhexoates and tri-2-ethylhexyl-phosphate, and 5 to 7 parts of zinc potassium basic chromate, all in a solution of low boiling solvents. (USP-119)

cf: 1.2.1
18.7.1
32.1.1
32.2.1
39.1.1
39.1.9
39.7.2

### Automotive Finishes

**39.4.1.** McMaster states that an automotive finish is applied with two purposes in mind; one is to protect metallic elements against corrosion; the other, to provide a pleasing appearance. These considerations naturally govern the tests used in evaluation. We do not care what a finish is made of so long as it does the job. All testing is done to performance specifications on the basis that a material under consideration must equal or better that in present use. When a choice must be made, it is desirable to have a factor of safety. Thus, if finish "A" will last ten years and finish "B" fifteen years, while the life of the automobile is ten years, either finish should be fully satisfactory. Such a choice is referred to as being made on the basis of "intrinsic worth" rather than on mere acceptability. (PM-6)

**39.4.2.** Makers of car and vehicle finishes are continually seeking to make their products more durable and more attractive and the modern car with its long-lasting paintwork testifies to their success over the last thirty years. Progress in car finish testing, including details of a new apparatus to simulate atmospheric conditions is reviewed. (PM-50)

**39.4.3.** A number of papers, presented at the National Passenger Car Body and Materials Meeting, Detroit, March 2-4, 1954 dealt with the finishing of automobiles. An abstract of these papers forms this article. The paper included:

Trends in New Automotive Finishes — R. B. Davis

Automotive Enamels — A. J. LaPointe

Lacquer as a Finish on Automobiles — R. J. Wirshing

Evaluation of Automobile Finishes — H. W. Redshaw (OF-30)

cf: 42.1.13

### Furniture & Wood Finishes

**39.5.1.** Cellulose lacquers are the most commonly used finish in the European furniture industry, according to a report published by the Furniture Development Council (England). This report also points out the prevalence of spray finishing in some countries and indicates the drying problems experienced by some manufacturers. It was compiled from the answers to a questionnaire sent to organizations in Germany, Austria, Belgium, Finland, France, Great Britain, Holland, Italy and Norway. (PM-49)

**39.5.2.** Sanches discusses the basic considerations in wood finishing. There are four excellent economic reasons for finishing wood:

1. protects the wood
2. enhances the beauty of the wood
3. makes wood easy to clean
4. increases sales appeal

Steps and materials considered are sanding, staining, filler, sealer, lacquer coating, rubbing, and polishing. (OF-35)

**39.5.3.** Mansell describes finishing processes for steel furniture. The finishes vary with the service requirements. Included are the preparation of the metal surface, prime-coating operations, selection of finish coats after careful testing, the finishing of metal dinette furniture, typical burn-off system a variation of the phosphate treatment, and the painting of outdoor metal furniture. (OF-40)

**39.5.4.** Hoge discusses the finishing of radio and TV cabinets by Wm. L. Hoge & Company. The finishing room is on two floor levels, the first being for production while the force drying is done on the balcony. (IF-15)

**39.5.5.** Bickel describes how he patches and repairs surface finishes. He describes the portable workshop which he uses for on the spot touch-up work, which includes such jobs as rubbing out fresh packing marks, lacquer stick build-up plus final finishing, highlighting, shading, Frenching Technique, scratch removal, etc. (IF-22)

**39.5.6.** Wyrwa describes the finishing of fine hardwood sewing machine cabinets at the White Sewing Machine Plant. This includes stain, dry, fill, pad in, lacquer sealer, then two coats of lacquer with drying following each one, then rubbing with portable air driven machines. (IF-25)

**39.5.7.** Amster describes the finishing of TV cabinets in France. (IF-29)

**39.5.8.** Cornwell describes the finishing of oak tables and mahoganized TV cabinets by Cornwell Co., Inc. Because the finishing operations on blond and "silver fox" coffee and occasional tables and on mahoganized TV cabinets are widely separated, their finishing room is located in two buildings and on two floors. (IF-38)

**39.5.9.** Neukam describes the finishing of fine office furniture by the Jasper Office Furniture Company. (IF-48)

**39.5.10.** A film-forming water in-oil dispersion for treating wood surfaces consisting essentially of from 2.25 per cent to 7 per cent by weight of wax, from 1.25 per cent to 5 per cent by weight of dimethyl polysiloxane having a viscosity within a range of from 100 to 30,000 centistokes at 25° C., from 10 to 20 per cent by weight of water consisting of droplets coated with said wax and the major portion by weight of a liquid solvent having an aniline point within a range of

from —22° to 185° F., a distillation range within the limits of from 190 to 450° F., and selected from the group consisting of hydrocarbons, ethers, chlorosubstituted hydrocarbons and mixtures thereof. (U P-116)

cf: 6.1.1

### Putty & Caulking Compounds

**39.6.1.** In a round table discussion presented at the Federation's 31st Annual Meeting in Atlantic City, October 31, 1953, putty and caulking compounds were discussed.

Papers included:

Introduction-H. Kelfer
Research & Development-R. S. McCleary
Equipment-H. W. Hibbert
Putty and Caulking Failures, Causes and Prevention-G. E. Hann
Specifications-W. M. Lawall
(OD-19)

**39.6.2.** Kelfer presents lecture XIV in the Third Ten-Year Practical Paint Course sponsored by the New England Production Club, on putty and caulking compounds. Question and answer period followed the lecture. (APJ-9)

**39.6.3.** Hibbert discusses the achievement of good paint jobs through high grade caulking compounds. In discussing these compounds, the author covers pigments, oils, and volatile solvents, surface preparation, conditions under which the compounds are used, and metal and asphalt. (PIM-23)

cf: 50.4.1

### Heat Resistant Coatings

**39.7.1.** Owens, et al, studied vehicles and pigments in high heat resistant coatings. All of the heat resistant colors tested, showed promise up to 700°F. The precipitated iron oxide, both yellow and black, showed definite color change to red in the region above 500°F. The cadmium yellow turned reddish bronze from about 400°F. up, while undergoing heating; on cooling returned to its normal color. All of the heat resistant colors seemed to do no better, in general, than the silicone in which they were dispersed. All of the heat resistant colors except selenium red & cadmium yellow were down graded when sprayed over a coat of the standard formulation. The cadmium selenium red showed as good performance over the bare metal as over the standard formulation, while the cadmium yellow showed poorest performance over both surfaces.

Both the DC-805 and SR-52 silicones showed a definite improvement over DC-801 or SR-61 silicones. The butyl titanates did not rate as well as the silicones. All of the heat resistant colors tested rated no worse than the vehicle in which they were dispersed. The use of a properly pigmented undercoating extended the heat resistance range of all the colors except cadmium yellow.

The outstanding heat resistant colors were cadmium selenium red and chromium oxide green. (OD-11)

**39.7.2.** Grupp discusses butyl titanate heat and corrosion resistant paints. Methods for polymerization of butyl titanates are discussed as are other additives to the paints. Formulations are presented for:

Aluminum Paint
Black Paint
Copper Oxide Anti-Fouling Paint
Green Chromic Oxide Paint
Red Oxide Paint
White Paint
Zinc Dust Paint
(OF-43)

cf: 39.1.1
50.1.10

### Printing Inks

**39.8.1.** Bowles reviews the past 25 years of ink research. During this quarter of a century the ink industry has passed through a complete era, during which time other vehicles have supplemented the original Baltic linseed oil used exclusively for making litho varnishes for inks. The author discusses ink consistency or "body", color, drying, adhesion and related interfacial phenomena, new printing processes, Candide in the new technology, and the progress of science. (JOCCA-38)

**39.8.2.** This second and concluding part of Varron's article on how inks dry include the following methods—precipitation of the resin, solidification, filtration, gelation, polymerization by oxidation and thermal polymerization.

A generalized picture of the process can be drawn. Initially there is gross penetration of the ink into the stock. This is followed by the separation of a portion of the vehicle from the bulk of the ink which results in the partial setting of the ink. Complete setting of the ink occurs when a gel structure is formed. The final phase involves the solidification of this gel structure. (PM-31)

**39.8.3.** The way in which research helps with problems was the theme of an exhibition held recently by the Printing, Packaging and Allied Trades Research Association. The exhibits are described briefly in this article. (PM-64)

### Solvent Resistant Coatings

**39.9.1.** Cowling, et al, review organic coatings adaptable to fuel storage. A considerable advance has been made in the technology of coating concrete designed for the storage of fuels derived from petroleum. Also, much information applicable to fuel-resistant coatings for steel has been acquired. Polymer types now acceptable for these applications are limited to the more inert vinyl resins, polysulfide rubbers, and vinylidine chloride-acrylonitrile copolymers. Vinyl coatings properly formulated and plasticized possess the required inertness to resist solvent attack. Their use alone is limited by their lack of extensibility particularly after aging. This is a serious defect in applications to concrete.

Polysulfide rubbers, do not possess the high degree of inertness needed but do display good adhesion and extensibility.

A copolymer of vinylidine chloride-acrylonitrile is among the more fuel-inert materials adaptable to fuel tank living. It can be used alone on steel but on concrete it is best used as an overcoating for polysulfide rubber.

The most significant achievement has been the development of a fully satisfactory lining using the materials in aqueous dispersion. Thus a greater film thickness can be applied and the solvent hazards are eliminated. (IEC-86)

cf: 39.1.1

### Antifouling Paints

**39.10.** (No abstracts)

cf: 39.1.1
39.3.18

### Fungicidal Finishes

**39.11.** (No abstracts)

cf: 36.3.1
36.3.5
36.3.11

### Adhesives

**39.12.1.** Grinsfelder, et al, treat some elementary, but basic factors involved in evaluating potential structural adhesives generally, including specific data for adhesives tested on polymethacrylate adherents and suggest a new approach to the problem of minimizing destructive testing in inspection procedures on bonded assemblies. (ASTM-7)

**39.12.2.** Marra presents the first of a series of articles on adhesives. This first article covers wood-to-wood bonding and includes theory of adhesion, wood adhesives, equipment and processes, cost, standardization and what remains to be done in the wood adhesives field. (MP-6)

**39.12.3.** Epstein presents the second of a series of articles on adhesives. This second article covers metal-to-metal bonding and includes theory of adhesion, design considerations, coefficient of expansion, typical adhesives, new adhesives, polyurethane resins and what remains to be done in the metals adhesive field. (MP-9)

**39.12.4.** Moser presents the third and concluding article in the series on adhesives. This third part deals with the use of synthetic resin adhesives in meeting the demands of a difficult and highly specialized application: bonding glass to itself and to other materials. (MP-12)

**39.12.5.** McLaren presents a general theory of the adhesion of high polymers to cellulose. The theory includes a consideration of the influence of: melt viscosity and tack temperature of polymers, kinds and numbers of polar groups in polymers, plasticization, temperature and nature of the surface. With cellophane-polymer systems polarity and hydrogen bonding are of paramount importance in adhesion. (MP-30)

**39.12.6.** Elam discusses the use of epoxy resin-based adhesives to bond metal-to-metal. Bond characteristics, strength under static and impact loading, and application factors are presented. (PE-4)

### Coatings For Textiles

**39.13.1.** Pigment dyeing and printing gaining ground in Europe but is not expected to replace classical processes. Pigments may be applied to practically all types of fibers with possible exception of polyvinyl chloride, even those derived from glass, and therefore to all types of blends, without being affected by the nature of dyestuffs, swelling agents, and textile aids.

An anology may be drawn between pigment printing and dyeing and the crease-resisting treatments based on urea formaldehyde and melamine formaldehyde resins, as well as with silicone waterproofing processes. (CEN-16)

cf: 21.1.10

### Organosols & Plastisols

**39.14.1.** Field coils on cranking (starter) motors and the generators which keep the car battery charged are now being coated with vinyl plastisols, supplanting the former method of covering these coils with heat-sealing cloth. Advantages of the grey plastisol covering include high resistance to gasoline and other petroleum products, water, organic and mineral acids, and alkalis. Furthermore, the plastic material has excellent resistance to abrasion, good heat stability, and is flame resistant. (MP-1)

**39.14.2.** Powell, et al, discuss vinyl resin organosols; suspensions of very finely divided vinyl chloride type resins in organic liquids which are capable of dissolving them at room temperature. After application, a baking operation serves to drive off any volatiles and to fuse the resin particles together into a strong film.

The rapid growth in the commercial importance of the vinyl resin organosols has served to focus attention upon this method of preparing coatings. It is believed to have wide applicability to relatively insoluble thermoplastic resins.

The various commercial grades of organosol resins have been compared briefly, and some of the general principles of formulation of both organosols and plastisols have been discussed. A few of the experimental approaches to a study of the physical chemistry of organosol systems have been reviewed briefly. (OD-27)

**39.14.3.** A single coat of colored plastisol applied on continuous production line meets every physical and chemical requirement in protecting oil control valves. (MP-29)

**39.14.4.** The Scientific Oil Compounding Company, Inc. has issued 4-page technical bulletin describing fungus resistant vinyl plastisols.

**39.14.5.** "Bakelite Vinyl Dispersion Resins for Organosols & Plastisols" is the name of an 8-page booklet just published by Bakelite Co. Included are typical uses, properties methods of application.

cf: 3.1.6
20.1.4

### Electrical Insulation

**39.15.1.** Christensen reviews silicone dielectric materials. As electrical insulating materials, silicones offer four advantages. Their use permits 1) substantial reductions in space and weight, 2) longer service life, 3) reliability when exposed to temperature and moisture extremes, and 4) above-average mechanical and electrical abuse. These advantages stem from one property—heat resistance. (PE-2)

**39.15.2.** Ryan presents the results of a study to determine the effect of in-pile radiation on some representative insulating structures. There is a possible correlation between chemical composition and the ability to resist high-intensity radiation. Highly phenylated structures appear to be more radiation resistant than aliphatic structures. Halogenated materials were not studied because they evolve corrosive halides. (MP-24)

### Coatings For Plastics

**39.16.1.** Brooks discusses the lacquering of polystyrene moldings. There are many reasons for wanting to apply a coating to a molded plastic. Adhesion is a major problem in the formulation of coatings and is accomplished by means of a solvent which will bite into the surface of the moldings and then dry out. The properties required of the coating are as follows:

1. Effective adhesion
2. No crazing effect
3. Color, luster and gloss

4. Minimum drying time
5. Simple means of application (brush, spray, or dip)
6. Resistance to temperature and humidity variations
7. Resistance to abrasion
8. Low cost

(OF-19)

**39.16.2.** Rudolph reviews the mass production painting of plastic products. In this review, photographs take the place of words in showing the various steps whereby these plastics are given decorative coatings. (OF-34)

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# EMULSION TYPE COATINGS

## CHAPTER 40

# EMULSION COATINGS

### General

**40.1.1.** Latex-base paints, near "revolutionary" in their impact a few years ago, boast still-climbing popularity. New twists, like making textured and patterned finishes, expect to bolster sales in 1954 but big hope to push up volume is drive on exterior paints. (CW-14)

**40.1.2.** Formal opening of the Gelvatex Coatings Corp. polyvinyl acetate paint plant in California in March boldfaced the fight between emulsion and oil paints. Production by Gelvatex, first to produce a polyvinyl acetate paint in the United States, will be increased sixfold by the new facilities. The new plant represents an interesting compromise between the old, multistory, gravity-flow paint plant and the "ranch style" one-level plan that has found recent favor with many firms. (CW-15)

**40.1.3.** Rowe & Bixler discuss brushing and leveling in latex paints. Brushability in latex paints has been shown to correlate with low viscosity at very high shear rates, confirming previous work of Asbeck on house paints.

For a given "consistency", 200 rpm by Krebs-Stormer or 60 rpm by Brookfield, an unhydrolysed soybean-protein thickener and protein-base thickeners in general, have been found to give lower viscosity at brushing shear rates and therefore superior brushability

The effect of evaporation on flow properties during normal brushout periods was found to be small, regardless of thickener type. A hydrophilic thickener can minimize thickening arising from penetration of the water into porous surfaces.

Leveling in latex paints appears to occur largely within the first few seconds after application, and is controlled by the viscosity of the paint, at the very low shear rates operative in the leveling process, during that time. Because of thixotropy, the very-low-shear viscosity of latex paints depends on the immediate past treatment of the sample: for this reason, leveling appears to correlate best with viscosity measured at very low shear immediately after the sample has been subjected to very high shear rates simulating the effect of brushing. Devices for making the measurements are discussed.

The superior leveling imparted to latex paints by the unhydrolysed soybean protein thickener has been traced to the temporary reduction of the low-shear viscosity by the action of brushing, permitting rapid flow-out of the film. (OD-2)

**40.1.4.** Massaro, et al, studied the pigmentation of emulsion systems. The specific aim was to determine the effect of the following types of preparation: 1) Three-roller mill, 2) High-speed mixer, 3) High Speed stone mill, 4) Colloid mill, and 5) Pebble mill upon the package stability and film characteristics of six latex paint formulations.

All of the results obtained clearly demonstrated that extreme variations in performance result from the preparation of latex paints by different procedures, even when—as in this study—only differences in the dispersion of the pigment were involved. It is believed that a number of unexpected variables in the manufacture and formulation of latex paints have been identified which, if properly controlled, may lead to more reproducible test results in the future work of this committee. (OD-12)

**40.1.5.** In a round table discussion presented at the Federation's 31st Annual Meeting in Atlantic City, October 29, 1953, water dispersed paint systems were discussed. Papers included were as follows:

Introduction
—W. J. Greco
Consumers' Reactions
—H. E. Hillman
Manufacture
—E. C. Scholl
Pigment Dispersions
—W. H. Hoback
New Acrylic Resin Dispersions
—N. J. Timmons
Binders
—H. F. Payne

(OD-17)

**40.1.6.** McLean in a lecture to the Scottish junior section of the Oil and Colour Chemists Association compared emulsion paint systems. Types covered included polybutyl methacrylate, styrene copolymer, P.V.A., polystyrene, styrene-butadiene, P.E. alkyd and styrenated oil. Polybutyl methacrylate emulsion paints exhibit the best brushability and levelling, while pentaerythritol alkyd products have the best adhesion and washability. (PM-59)

**40.1.7.** Fletcher, et al, describe a systematic investigation of the most common failures of polyvinyl acetate emulsion paints and show how the information obtained can be used to prevent the occurrence of defects.

The following problems are discussed: viscosity and shade variations during storage, stability to freezing, the development of uneven finishes, pinholing and cratering, drag on recoating, loss of adhesion including blistering and flaking, discoloration, and the ef-

fects of efflorescence. (JOCCA-33)

**40.1.8.** Smith reviews the latest developments in polyvinyl acetate emulsion paints. One of the most significant developments in the paint industry has been the rapid growth of paints based on emulsion polymers.

Properties of polyvinyl acetate which make it suitable as a paint vehicle include, transmission of water vapor in either direction, stability of emulsions of polyvinyl acetate, good life indoors and out, only water needed to wash out brush or roller, surface of polyvinyl acetate emulsion paints improve with age, unaffected by fats, vegetable and animal oils, adhesion is satisfactory over wide range of surfaces, emulsion paints used as stain barrier over asphalt, ease of application, good freeze-thaw stability. (CPVM-7)

**40.1.9.** Smith continues his review of the latest development in polyvinyl acetate emulsion paints. In this second article he discusses pigments, fillers and extenders, water, and other ingredients used in their manufacture. Also included is a discussion of the compounding of polyvinyl acetate emulsion paints. (CPVM-11)

**40.1.10.** Ulrich discusses the theory and practice of vinyl emulsion coatings. Topics discussed include film formation and properties, freeze-thaw stability, pigmentation, whites and extenders, yellows and reds, blues, greens and blacks, aluminum, pigments affect viscosity, pastel shades, making the paint, storage, film characteristics, application, as finish or undercoat, and other uses. (PT-2)

**40.1.11.** Payne reviews latex paints. Included are: introduction, comparison with oleoresinous paints, composition of latex paints, plasticizers and alkyd resins, protective colloids, pigment dispersion, surface active agents, defoamers, freeze-thaw resistance, efflorescence, pigments, methods of manufacture, and method of film formation. 36 references are cited. (JOCR-3)

**40.1.12.** Henson presents lecture VI in the Third Ten-Year Practical Paint Course Sponsored by the New England Production Club. The lecture, on latex paints, was followed by a question and answer period. (APJ-2)

**40.1.13.** Schroeder discusses latex paints. Included are pigmentation, extenders, protective colloids, and latices (polystyrene, polyvinyl acetate, acrylic). (APJ-3)

**40.1.14.** The method of forming a multicolor coating composition comprising providing a plurality of differently colored lacquer portions, mixing each of said portions with an aqueous suspension of a protective colloid at an elevated temperature, diluting each of said mixtures with water and combining said diluted mixtures. (USP-53)

**40.1.15.** A stable lactic casein solution comprising lactic casein which has been freed from active proteolytic enzymes by heat treatment in the range of about 30 minutes at about 150° F. and about 10 to 30 minutes at about 170° F., water to produce approximately a 10% to 30% by weight lactic casein solution, and, for each 100 parts by weight of lactic casein, between about 10 and 40 parts by weight of borax, between about 2.5 and 10 parts by weight of boric acid, between about 1 and 5 parts by weight of a sodium salt of a mono-chlorphenylphenol and between about 0.25 and 1 part by weight of sodium pentachlorphenate.

A stable pigmented emulsion paste paint made by intimately mixing a mixture comprising between about 20 and 60 parts by weight of a stable lactic casein solution as described in claim 1 together with approximately 4.3 parts by weight of a drying oil, approximately 2.0 parts by weight of an ammonia soap, approximately 9.6 parts by weight of a mineral pigment and approximately 46.4 parts by weight of a mineral filler. (USP-64)

**40.1.16.** A coating composition comprising an aqueous solution of potassium silicate of 15° to 25° Be. as a vehicle and containing about 8 to about 11 pounds, per gallon of vehicle, of a composite pigment materials in proportions by weight within the indicated ranges:

| | Parts |
|---|---|
| Silica | 40 to 70 |
| Barium sulfate | 25 to 40 |
| Titanium oxide | 5 to 20 |

and 4% to 10%, based on the volume of the composition of an emulsion composed of about equal proportions by volume of a rubber latex and an oil of the class consisting of animal and vegetable oils. (USP-134)

**40.1.17.** A paint latex comprising an oil-in-water emulsion polymerization product of a major amount of an aromatic mono vinyl compound and a minor amount of a conjugated diolefin containing stabilizing amounts of thiourea. (USP-153)

**40.1.18.** Sherwin-Williams introduced Applikay—a translucent, opalescent paint for application by an embossed plastic roller over Super Kem-Tone latex paint; both paints being water-thinned.

cf: 1.2.1
19.3.1
19.4.5
21.1.12
23.1.2
36.8.1
36.8.5
38.1.13
44.2.21
46.1.8
46.1.17
49.3.1

### Interior Wall Paint

**40.2.1.** Holmes discusses the decoration of fibrous plaster with water paints. Defects in water paint films to fibrous plaster are described. Fibrous plaster—a lining material widely used in Australia—although an excellent product in many respects has certain unusual physical characteristics. These are accentuated by its mode of employment as a wall and ceiling lining and give rise to certain difficulties when decorated with water paints is attempted.

Investigations into the nature of certain of these defects are described. A common form of discoloration is shown to be the sulphides of heavy metals, chiefly lead, introduced as driers when the plaster is sealed with oil-bound composition: the sulphide radical is believed to result from bacterial decomposition of protein in the water paint.

Field studies are described which illustrate the utility of oil-bound sealers in reducing flaking of water paint films but it is pointed out that the sealers used must be free from drier metals that could cause sulphide staining.

Some aspects of mold growth on water paints are discussed. Under certain circumstances mold growth is stimulated by the physical prop-

erties of fibrous plaster linings.

Since both fibrous plaster and ordinary water paints have limitations which may interact critically it is desirable either to take special precautions as regards the treatment and installation of the sheet or to employ paints that are less susceptible to the effects of moisture and microbial action than the simple water paints. (JOCCA-29)

**40.2.2.** The widespread acceptance of latex paints has been due to the outstanding advantages which they offer. Bertollo describes their composition, manufacture and properties. Although they are a commercial success, very little is known concerning their actual colloidal structure and the specific effects of the individual paint components. (IR-1)

**40.2.3.** Davis discusses the formulation and manufacture of interior flat latex-emulsion wall paints. The author covers pigments and extenders, pigment volume concentration, pigment aids and dispersants, emulsification procedures, modified latex emulsion paints, use of driers in unmodified systems, extension of wet-edge time, protein processing methods, use of thickeners, freeze-thaw stability, adhesion of latex-emulsion paints, fungicides and their use, defoamers and their use, handling and storage of latex, equipment and paint processing, important properties of latex paints. Appendix I includes various formulations for latex paints. (POCR-15)

cf: 38.2.1
38.2.8

### Exterior Masonry

**40.3.** (No abstracts)

cf: 39.9.1

### Fire-Retardant Paints

**40.4.1.** Cummings investigated an aqueous fire-retardant protective coating system of the intumescent type as a continuation of work in the development of a synthetic latex product. Twelve different types of synthetic emulsions were studied; a vinyl chloride-vinylidene chloride copolymer emulsion, was selected as most useful. Properties of the oven-dried coating studied include wet scrub-resistance, quality of intumescence, and resistance to conditions of high temperature and high humidity. (IEC-87)

**40.4.2.** A water reducible potentially reactive fire-retardant coating composition which comprises in combination: (1) 1% to 1[illegible]% of an alkaline catalyzed amide aldehyde resin wherein the amide is selected from the group consisting of urea, thiourea, butyl urea, hydroxy urea, ethanol urea, guanyl urea, diethylene triurea, acetyl urea, allyl urea and ethylidene urea; (2) 5% to 35% of an acidic ammonium phosphate catalyzed condensation product of an aldehyde and a second amide selected from the group consisting of cyanamide, dicyandiamide and guanidine; (3) 35% to 55% of an inorganic ammonium salt capable of releasing ammonia under flame conditions; (4) 7% to 12% of a monomeric saturated aliphatic organic compound selected from the group consisting of dicarboxylic acids, hydroxy dicarboxylic acids, acid salts and salts of said acids containing not less than 1 nor more than 8 methylene groups and (5) the remainder of the composition consisting of a blend of pigments comprising china clay and zinc oxide. (USP-138)

# APPLICATION AND FINISHING METHODS

## CHAPTER 41

# SURFACE PREPARATION

### General

**41.1.1.** Miller & Hedman describe a simple test procedure for screening metal cleaners, a test which can be used for determining optimum cleaning cycles for metal panels. The methods for preparing the test specimens and representative examples of the data obtained are included. (ASTM-6)

**41.1.2.** The reasons for priming Keene's and similar plasters following the trowel and the related questions of the composition of plasters and of primers were discussed by Mack before a meeting of the London Section of the O.C.C.A. This is a report on that lecture, and on the discussion following the lecture. (PM-32)

**41.1.3.** Prerequisite for most metal finishes is a clean metal surface. You must consider contamination present, the metal, part design, subsequent operations, equipment needed, operating conditions, special precautions, production volume, and cost, in selecting metal cleaning methods. Campbell presents a complete and unique comparison of standard metal cleaning methods that will help in the selection of the optimum method for the individual particular application. (MM-2)

**41.1.4.** Trumbour reports on simposium on the subject of phosphatizing held at Bedford Springs, Pa., Sept. 1953.

Phosphatizing dates back to third century A.D. Forerunner of modern phosphate coatings traced to German patent issued in 1879 which suggests treating heated steel article in a solution of alkali and ammonium phosphate.

Phosphate coating acts as a chemical "go-between" the metal and paint film and acts to prevent undercutting or creeping corrosion from areas where a paint film has been broken as by scratching.

Phosphate coatings consist of crystals of zinc, iron or manganese phosphates deposited on the metal surface in thicknesses of 0.00004 to 0.0002 inches for paint bond application. The paint film actually becomes integral with the phosphate coating, which in turn is strongly bound to the metal surface. In essence, the phosphate coating serves as a kind of primer pigment.

A typical application cycle includes: (1) clean; (2) Rinse; (3) Pickle; (4) Rinse; (5) Activate; (6) Phosphate; (7) Rinse; (8) Chromic seal; and (9) Dry-off. (OF-3)

**41.1.5.** Further finishing of aluminum is normally unnecessary except for two main classifications of circumstances where coating is necessary or desirable. These are: to prevent corrosion under prolonged or severe exposure conditions and to maintain a particular surface appearance—mainly for purposes of decoration.

The various aspects discussed include—cleaning the surface, surface pretreatment, primers, the final surface and anodizing. (OF-6)

**41.1.6.** Engel presents a survey of metal surface soils and their removal. The metal surface soils considered include cutting oils, drawing and forming compounds, buffing compounds, and other soils. Cleaning methods include alkali cleaning, soaps, sandblasting, flame degreasing, and pickling. Two tables are included on composition of different soils (cutting oils and drawing and forming compounds-coolants), and one on the comparative efficiencies of methods for the removal of mineral oils and greases. (OF-32)

**41.1.7.** Starr discusses the new priming technique to apply corrosion-inhibiting finishes to various metallic surfaces at Consolidated Vultee Aircraft Corporation (Calif.). The technique involves the preliminary use of a thermosetting wash primer, over which a vinyl zinc chromate seal primer or cover coat can be applied. (PF-4)

**41.1.8.** Gurnham reviews ultrasonic cleaning. He discusses sonic energy generators, sonic energy losses, uses of ultrasonic energy, and ultrasonic metal cleaning. (PF-5)

**41.1.9.** Zimmerman reviews flat polishing and application to plating, painting, and sizing. The author describes the history and application of flat polishing, then goes into the construction of the machine, the principle of operation, evaluating the belt, selecting the sequence, finishing, effect of rubber, rubber contact wheel applications, and wet versus dry polishing. (PF-9)

**41.1.10.** Harris discusses recent data on sensitivity of metal cleanliness tests. An increased sensitivity radiotracer method is described, and a comparison of the sensitivities of several methods is provided. A compilation has been made of the many methods used for cleanliness, indicating the principle of action and original reference. (PF-12)

**41.1.11.** Sherwood describes emulsifiable-solvent cleaning of metals. A comparison is made of types of pre-cleaners: solvent cleaning, alkaline soak, vapor degreasing, emulsion cleaners, and emulsifiable solvent cleaners. Composi-

tion and properties of emulsifiable solvents and operating technique are discussed. (MF-3)

**41.1.12.** Barbian describes a finishing system for magnesium. The author explores 1. the requirements for finishing magnesium, 2. finishing systems currently used, 3. service experience of magnesium finishes, and 4. new developments for finishing magnesium. (IF-14)

**41.1.13.** Bardin reviews the cleaning and conditioning of metal surfaces for coatings. Metal cleaning and surface treating, in preparation for the application of organic coatings have been developed to such a degree that it is now possible to economically process any metal product, regardless of what is on its surfaces. Choice of methods, materials and facilities will depend upon the product and individual plant conditions, plus the volume and speed of production that are wanted. (IF-32)

**41.1.14.** Gibson discusses the the preparation of metal surfaces for industrial finishes. The author covers the cleaning of metal surfaces, organic solvent cleaning, alkali cleaning, emulsion cleaning, pickling, mechanical cleaning, chemical coatings, phosphate coating, phosphates coating mechanism, operation of process, paint tests, and summary. (APJ-53)

**41.1.15.** Johnson discusses metal preparation prior to painting to get the most out of metal finishes. The author reviews the removal of greasy substances, vapor phase degreasing the best; rust removal, most common method; surface etching and passivation; proper etching; and equip for size. (CPVM-19)

**41.1.16.** Schleicher in part I of his article on protection of steel discusses the importance of surface preparation.

Methods discussed are:

I Chemical and Solvent Method
- a. natural weathering
- b. solvent cleaning
- c. pickling
- d. phosphate treatment

II Physical Methods
- a. hand cleaning
- b. power cleaning
- c. sand blasting
- d. flame cleaning

(IM-24)

**41.1.17.** A composition for treating solder metal surfaces that have been prepared for such treatment by application thereto of an alcohol solution of phosphoric acid consisting of about 69% by weight of metallic zinc dust, about 13% by weight of pigment zinc chromate, and about 18% of an isopropyl alcohol.

An article including a solder-metal area having surface pits or cavities filled with a reaction product which results when an alcohol solution of phosphoric acid is first reacted with a solder-metal and the ensuing product is reacted with a paste of about 84% metallic zinc dust and about 16% pigment zinc chromate, said fillings being bonded to the wall surfaces of said pits by reaction of the phosphoric acid portion of said reaction product with the solder metal forming the wall of the cavity. (USP-66)

**41.1.18.** The process of concealing minor defects in a surface being covered with a flat finish of oil or water base paint consisting of first covering the defect with a thick paste consisting of common ground mica mixed with a sufficient quantity of the particular covering paint, and thereafter applying the paint while the paste is still wet. (USP-71)

**41.1.19.** Chas. Pfizer & Co., Inc. has issued 3-page technical bulletin No. 15 describing the use of citric acid and ammonium citrate dibasic in the removal of rust, scale, and embedded iron.

**41.1.20.** Chas. Pfizer & Co., Inc. has issued 17-page technical bulletin No. 61 describing "Chemicals for Metal Finishing".

cf: 1.2.1

Manufacturers:
American Chemical Paint Company
Enthone, Inc.
Chas. Pfizer & Co., Inc.

### Phosphate-Type Cleaners And Treatments

**41.2.1.** Kronstein, et al, present a study of metal-phosphate coatings on steel as a base for paint application.

It is, in particular, concerned with the problem of comparing the amount of insoluble phosphate coating matter which is produced during application from a water solution of the initial material and also with a study of the effect of the remaining water soluble material present in the phosphate coating on subsequent paint applications.

A method is presented for comparing the content of water soluble matter in phosphate-coated panels. The method is also used to compare the effect of the same pretreatment materials and methods to different metals. (PVP-16)

**41.2.2.** Gabrielson has developed a method for the determination of the metals present in phosphating solutions. The method is rapid, convenient, and of sufficient accuracy for phosphating baths and concentrated phosphate solutions. (MF-1)

**41.2.3.** Ayres discusses the phosphating of steel prior to painting. The phosphating processes now in wide use for pre-paint conditioning result in the conversion of a microscopically thin surface layer of the metal into a minute crystalline film of insoluble metallic phosphates.

The coating, which is integral with the basic metal, greatly improves the metal's capacity to adsorb paint, and thus improves adhesion between metal and paint. The paint is locked to the crystals, and the crystals are locked to the metal. (IF-8)

**41.2.4.** The Detrex Corp. introduced a group of phosphoric acid-type cleaners (800 Series), intended for products that are too large or heavy to be phosphate coated by normal production methods.

Manufacturers:
American Chemical Paint Company
Cowles Chemical Company
Detrex Corporation
Pennsylvania Salt Mfg. Company

### Paint Removers

**41.3.** (No abstracts)

Manufacturers:
The DuBois Co., Inc.
Enthone, Inc.
Pennsylvania Salt Mfg. Company

## CHAPTER 42

# APPLICATION METHODS

### General

**42.1.1.** Durability of paintwork is a particular quality demanded by heavy-duty vehicle operators. To combine this with appearance and, at the same time, keep production flowing is the manufacturer's problem. At the Lancashire factories of Leyland Motors Ltd. quite a number of processes and different types of plant have been adopted to integrate production and demand. (PM-7)

**42.1.2.** Hyler describes the various finishing and allied problems encountered in the Caterpillar Tractor Company Plant in Peoria, Illinois. This plant uses sealers, primers and enamels from three leading sources of supply. Description of facilities includes testing, paint mixing and feeding, line cleaning, pickling of sheet metal, paint spraying, drying, rubber tire finishing etc. (OF-1)

**42.1.3.** Mansell describes the changing aspects of automotive finishes and their testing. Included are, how finishing materials have changed, pigmentation problems, appearance of baked synthetics, paint material and methods control, hardness, gloss, color and humidity tests, special tests for finish enamels, corrosion control, and reclamation of Over-Spray Paint. (OF-4)

**42.1.4.** DeBurgh discusses the conveyorization of furniture finishing. Finishing room techniques in furniture factories have little changed since Grand-dad's day. The introduction of spray guns represents the single great forward technical step in the past half-century. Indirect labor, should and could be estimated by the utilization of finishing room conveyorization.

The various steps needed for conveyorization are discussed. (OF-11)

**42.1.5.** Jackson describes the custom-finishing of busses and trucks as conducted at the Kenworth Motor Truck Corp. in Seattle, Washington. Phases described are cleaning and priming, assembly finishing and bus finishing. (OF-17)

**42.1.6.** Yacko describes the finishing of small parts and discusses the calculation of finishing costs. The methods for applying organic coatings to small parts fall into three general classifications:

1) Roller coating providing high-speed application and best material economy.
2) Dip finishing providing complete coverage to whatever parts are being finished.
3) Spray coating providing greatest versatility with regard to parts to be coated and materials available.

In the calculation of finishing costs, the two factors which most affect these costs are the method of application and the materials used. Approximate figures for efficiency of various application methods are as follows:

| | |
|---|---|
| Spray Finishing | 30-60% |
| Spray Finishing with Electrostatic Aids | 75-95% |
| Dip Finishing | 80-90% |
| Roller Coating | 90-95% |

(OF-18)

**42.1.7.** Nesbilt describes an automobile refinishing installation in Quebec, Canada. Various aspects of automobile refinishing are included. (CPVM-8)

**42.1.8.** Walter discusses air filtering systems for finishing operations. Since an air stream is essential for carrying away vapors and this air stream must not deposit any contamination on the work, filtering the air is a must. The author discusses a number of systems including room air filters, moving viscous filters, dry air filters, electrostatic filters. He also discusses the choice of filters. (OF-28)

**42.1.9.** Ross discusses how uniforms and clean linen towels raise the morale in finishing operations. The cleanliness and particularly clean and fresh appearance of the man or woman employee does much to inspire confidence. For this reason, the matter of always having fresh, clean uniforms, and linen towels has become an important morale building point. (OF-37)

**42.1.10.** Starr describes the finishing of reclaimed materials. A variety of scrap materials-such as sawdust, leather dust, cotton flock, etc.—are now being converted into saleable products by mixing them with organic resins and using them as molding or casting compositions. The finishing of these articles to make them presentable and saleable involves a number of considerations. For example, reclaimed wood moldings must be finished like standard wood products, for they are almost as porous as kiln-dried timber. (OF-45)

**42.1.11.** Blount describes the finishing of surgical equipment at the Ohio Chemical and Surgical Equipment Co. (Madison, Wisc.). Exacting requirements of equipment for our nation's hospitals makes necessary a wide variety of durable corrosion—resistant sanitary finishes which at the same time must create a pleasing ap-

pearance for these important products. (PF-1)

**2.1.12.** Fecht discusses work simplification programs for the metal finisher. The Who, What, Where, When, How and Why is divided into two groups:

A. Work Simplification Process:
   1. State the problem
   2. Gather the facts
   3. Analyze the facts
   4. Develop the solution
   5. Apply the solution

B. Solving the Problem:
   1. Select an operation to improve
   2. Break down the job in detail
   3. Question the job and each detail of the job
   4. Develop the new method
   5. Apply the new method

(PF-7)

**42.1.13.** Van Deventer discusses automotive paint processes and equipment. Not only are paint processes and equipment interdependent with material, but in many cases one portion of the process will have a definite effect on many of the operations. In order to produce paint jobs of the required durability at minimum cost, each part of the painting process must be carefully evaluated along with the associated equipment.

Improvements in all operations which have a part in producing a surface of the best quality prior to application of color coats can have a substantial effect on the finished job. (PF-10)

**42.1.14.** Hutchinson discusses flocoating and electrostatic airless atomization in modern industry. Modern flocoat machines are so constructed that practically all of the material consumed ends up on the work being painted. Then, coverage figures of something like 1800 ft. 2/gal. are possible in production. (PF-11)

**42.1.15.** Burt describes the painting of McCulloch engines. Operations include solvent spraying (cleaning), water wash spray booths, hot spraying of prime coats and enamels, overhead electric ovens, overhead monorail and flat-bed conveyors, and facilities for final testing and inspection. (IF-1)

**42.1.16.** Deisenroth describes the preparation and painting of metal furniture at the Troy Sunshade Company (Ohio). (IF-2)

**42.1.17.** Blackmore reviews a half decade of finishing progress. Mention is made of epoxy type resins, higher solids finishes, vinyls, silicone resins, etc., offer special merits, water thinned paints offer problems and possibilities, new sealer for modern wood finishes, paints sprayed from aerosol containers, electrostatic spraying, airless atomization, flow coating, catalytic fume combustion and a consideration of what the future may bring. (IF-5)

**42.1.18.** Seiwert reviews the painting of small parts using an adaptation of a conveyorized type finishing system (normally requiring a large amount of floor space), which requires a minimum amount of floor space. It is designed as an integral assembly so that it can be moved to any location in the plant in case layout rearrangements are made later. (IF-10)

**42.1.19.** Jackson describes the custom painting of truck cabs and chassis at the Freightliner Corporation Plant at Portland, Oregon. Custom jobs call for a variety of materials. A new paint specification sheet has to be made up for each order. (IF-13)

**42.1.20.** The development of facilities for applying coatings has been greatly accelerated since the use of protective and decorative coatings on practically all types of products has been elevated to its rightful place of importance throughout most industries.

Industrial establishments are now using facilities that produce perfect conditioning of:

1. surfaces to be coated
2. coating materials about to be applied
3. air as to its temperature, humidity, and rate of flow in the area where the coating operation occurs.
4. air movement in the drying area or baking oven.

(IF-17)

**42.1.21.** Connelly discusses how pin-holes can result from any of several causes and remedies for same. For less mahogany finish trouble, fill carefully, dry carefully, and spray carefully. (IF-18)

**42.1.22.** Jarus and Grezanik describe the finishing of lighting fixtures. Two methods of metal cleaning are used, fluorescent fixtures are hand sprayed in white, parts for fixtures are coated by electrostatic spraying, and coated parts are infra-red oven baked. (IF-21)

**42.1.23.** Gauss describes how Studebaker improved its body painting setup. Improvement of the finish was achieved by the application of a heavier film of primer surfacer than was practical on most cars. Since facilities to apply this heavier coat were inadequate, new electrostatic spraying equipment was installed. (IF-23)

**42.1.24.** Roberts describes the automatic cleaning flow-coating and baking of "Mult-A-Frame" steel channels. These channel frames come in standard 10-ft. and 20-ft. lengths, and since they must be coated both inside and outside, they travel through the entire system in a vertical position. The entire finishing system is a mechanical operation even to loading and unloading the conveyor. (IF-24)

**42.1.25.** Stewart describes a conveyorized setup that includes cleaning and phosphatizing of steel parts, dry-off oven, tack rag wiping, pressurized spray room, central mixing-storage facilities, electrostatic automatic spraying of heated paint material, supplementary hand spraying and oven baking—designed to take care of processing parts of many different sizes. (IF-27)

**42.1.26.** Syer describes the painting of metal products in Singapore. The author spent 5 months observing operations in a plant manufacturing metal containers. Metal finishing in Singapore is a far cry from what it is in the United States. (IF-28)

**42.1.27.** Chester describes the troubles which can be encountered in using silicon-containing finishing materials. The main trouble is the formation of "pits" in the finish causing rejection. (IF-30)

**42.1.28.** Syer continues his description of painting metal products in Singapore. (IF-39)

**42.1.29.** Rudolph describes how a new cleaning-painting setup has solved several problems at the Erie Plant of Detroit Steel Products Company. (IF-40)

**42.1.30.** Syer continues his article on painting steel drums in Singapore. (IF-41)

**42.1.31.** Golding describes the painting of military planes at the Columbus Division of North American Aviation, Inc. (IF-45)

**42.1.32.** Silver describes the flock coating of fiber board. The adhesive is spread by a roller coater, rayon flock is put on by machine, and the fast drying is effected in an infrared oven on an automatic production line. (IF-49)

**42.1.33.** Marshall, in Lecture XVII in the Third Ten-Year Practical Paint Course sponsored by the New England Production Club, discusses application and rigging. Rigging refers to the means of getting the person applying in the best possible location to make his application. Application refers to the devices or means used to carry the paint from the can or paint pot to the surface where it is to go. (APJ-24)

**42.1.34.** Slocum reviews the methods for application of paints. The author discusses spraying, electrostatic spraying, hot spray application, dip coating, flow coating, roller coating, etc. Any product that can be dipped also can be flow coated, but the reverse is not true. (APJ-64)

**42.1.35.** Cook describes the finishing of heating specialties—enclosures for radiators and component parts for heaters, etc.,—at the C. A. Dunham Co., Ltd. (Toronto). A special type of paint is required because these enclosures and parts are subjected to many attacks during use. The paint must be resistant to heat, alkali, etc. (CPVM-16)

**42.1.36.** Cook describes the finishing of typewriters at Smith-Corona (Toronto). The methods and materials used are discussed. (CPVM-23)

**42.1.37.** A small but ingenious finishing system turns out quality lacquer finish on pens and pencils. Nitrate lacquer is used. (CPVM-25)

**42.1.38.** Cook describes quality finishing at Mitchell Mfg. Co. (Toronto). In a carefully planned finishing department, they handle a wide variety of lighting fixture parts. (CPVM-31)

**42.1.39.** Cook describes the finishing of fire engines at the La France plant in Toronto. (CPVM-36)

### Spray

**42.2.1.** Tilney describes the development of three techniques for electrostatic paint spraying. The first is an air atomised spray process. Next is the electrostatic detearing process. The third and most recent development is the use of an electrostatic field both to atomise the coating material and to deposit it on the workpiece. (PM-8)

**42.2.2.** Fairrie offers a simple explanation of the hot spray process; its advantages and method of operation. Already 90% of industrial painting in Sweden and 50% of that in Holland is carried out using the hot spray process. It is, therefore, natural that Swedish engineers and chemists, by virtue of their overall experience, should have developed two really efficient plants designed in conjunction with the paint industry. (PM-9)

**42.2.3.** Hindle concludes that in the spray technique for the application of paint, modern man was anticipated ten to twenty thousand years ago by his cave-dwelling ancestors. He bases this on the discovery in certain caves in southwestern Europe, of pictures painted by various races of palaeolithic man wherein many of the figures, and especially the manes of horses, have smoke like outlines. The pigment was almost certainly blown on to the surface either in the form of powder or a dilute suspension. In support of this view, hollow bones filled with pigment have been found scattered about on the floor of the cave. (PM-19)

**42.2.4.** Preuss describes how standard spray gun parts can be varied to accomplish specific purposes and describes special types of guns developed for unusual applications. (OF-2)

**42.2.5.** Pouilly discusses the spray-application of porcelain enamel. Various types of equipment and proper spray technique are discussed. (CPVM-3)

**42.2.6.** Austin of England has spent much time and money in developing an efficient dual finishing system. Various phases of the finishing of Austin Motor Cars at Birmingham, England are described. (CPVM-13)

**42.2.7.** Rudolph describes the painting of water heaters at the Hotstream Heater Co. (Ohio). Increased production was being bottlenecked by its painting department. Study of the plant and painting requirements evolved two painting "lines" for large and small water heater components and various other products. Heart of the new painting "lines" are electro-static painting booths, fed by several hundred feet of monorail conveyor. (OF-20)

**42.2.8.** Stewart discusses the electrostatic finishing of freezers and air conditioners at the Amana Refrigeration plant (Iowa). An important phase of their plant is a new, complete electrostatic-two-coat, two-bake finishing system. (OF-25)

**42.2.9.** Pustarfi, discusses the function and design of water wash spray booths. Advantages of wet booths over dry booths are:

1. Present high speed production requires full time operation of spray booths. Dry booths are inadequate for this service since the over-spray deposit on the walls of the booth requires a disproportional amount of cleaning time to prevent a serious fire hazard.
2. Paint overspray in dry booths constitutes a definite health hazard.
3. Wet booths cut down on number of damage suits resulting from the deposit of air borne spray to neighboring cars and buildings.
4. Efficient water wash booths are more economical to operate, since maintenance costs and down time are reduced to a minimum.

(OF-26)

**42.2.10.** Renfrew & Freeman review the flame-spraying of plastic coatings. The application of plastic coatings by a non-solvent flame-spray technique followed the development in Europe of special equipment for the flame spraying

of powdered metals. Solvent-free coatings offer superior barrier properties in protecting metal surfaces against corrosion, mainly because a thick film can be deposited. Advantages are as follows:

1. heavy film without seams can be applied
2. thickness can be varied allowing heavier coating at points of heavy wear
3. no solvent hence no solvent retention
4. coating is "ready-for-use" on cooling—no "drying time"
5. odd shapes can be coated.

Disadvantages include:

1. flame spraying is an expensive operation
2. plastic tends to be degraded in the operation.

(OF-33)

**42.2.11.** Racine describes the progress made in water wash spray booth maintenance. To keep these booths operating efficiently at low cost, it is necessary to use a paint booth compound in the recirculated water. The purpose of this compound is to prevent the overspray from adhering to the walls of the booth and/or clogging the pumps and piping of the water circulating system. General recommendations are given for different types of paint sprayed. (OF-36)

**42.2.12.** Prauss describes the airless spray of finishes. Airless spraying allows the finishing of machinery units too large to move into a spray booth. Because of more efficient utilization of material, nearly 90% of material wastage is eliminated. The system provides a 50% increase in the finishing speed.

The system involves building up a pressure in the fluid which is then heated to a predetermined value. Heat lowers the viscosity and it builds up a vapor pressure whereby the tail-end fractions of the solvents are brought to a boiling point, and upon release to atmosphere the flashing off of the solvent assists in atomization, thus the solvents within the paint are used as an atomizing agent. (OF-4)

**42.2.13.** Pouilly discusses the electrostatic spraying of porcelain enamel. Much has been done to obtain in the porcelain enamel field, the high degree of efficiency enjoyed in the electrostatic spraying of synthetic paints. (PF-3)

**42.2.14.** Green discusses spray gun efficiency. The author describes the production spray gun, air valve of spray gun, fluid valve of spray gun, graduated spray width adjustment, spraying procedure, the spray gun cap, multiple jet air cap, fluid tip or material nozzle, training the operator, adjusting spray guns on a circulating system using lacquer, and defective work by good air cap; causes and remedies. (IF-3)

**42.2.15.** Beacham reviews spray equipment, including improved spray guns, low pressure spraying, circulating paint systems, steam spray, catalyst spray, light weight guns, automatic spray systems for long runs, hose, hose connections, air cleaner-filters, spray booths and spray exhaust systems, and flock coating by modern spray methods. (IF-9)

**42.2.16.** Bede discusses airless spray, an outgrowth of hot spray. Hot spray was made possible by the development of a practical and acceptable electric explosion-proof paint heater. A logical outgrowth of the hot spray process with the heated paint has been the airless atomization of the heated paint. All types of finishes are adaptable to airless spraying. Airless spraying opens up an entirely new level of operation in spray painting operations. Not only will it eliminate much of the waste, but it will also produce an excellent finish with great adhesion and a number of other fine qualities. (IF-11)

**42.2.17.** Slikkers describes the painting of steel equipment for stores by the Bulman Co., Inc., manufacturers of adjustable steel wall shelving, counters and island display units. (IF-16)

**42.2.18.** Rudolph describes the painting of factory-made steel panels for new partitions. This includes putting on adhesive to bond sheet steel to thick paper backing, cleaning surfaces of metal panels by wiping with solvent and tack rag, electrostatic spray painting both the primer and the enamel, baking in a gas fired oven, then safe packaging. (IF-20)

**42.2.19.** Frederick presents an example of equipment designed and put in to provide an adequate supply of filtered, preheated, make-up air, for use in a paint spray room that has only two spray booths. (IF-26)

**42.2.20** Samuelson describes the electrostatic spraying of shock adsorbers. Where 350 parts were formerly coated from each gallon of enamel, 1000 parts are coated per gallon. A consistent high quality, uniform coating is maintained too. (IF-35)

**42.2.21.** Rowe describes the panel arrestor method of removing paint overspray from air exhausted from the paint spray booths. The general method is described first, followed by a detailed description of a typical installation. (IF-37)

**42.2.22.** Johnson presents part II of "Getting the most out of Metal Finishes," Good application depends not only on quality spray equipment, but also on proper ventilation control. The question of air flow in spray booths is one of great importance as it controls the removal of overspray which would otherwise be deposited on the work. (CPVM-21)

**42.2.23.** Grinrod describes a British truck finishing booth wherein water recirculates after paint is removed by efficient water wash system. The water wash system is effective in removing overspray. (CPVM-27)

**42.2.24.** Chatterton reviews spray painting without compressed air. The airless spray system promises all the advantages of reduced overspray plus improved adhesion. (CPVM-34)

**42.2.25.** Murphy describes electrostatic paint spraying and how it improves efficiency and safety. (PIM-22)

cf: 42.1.1
42.1.22

Manufacturers:
Binks Mfg. Company
Burdett Mfg. Company
M. & E. Mfg. Company

### Roller

**42.3.1.** Hyler describes the application of finishes by roller coating. Paint and finishing materials are applied fast by the roller-coating method and the machines used are readily operated by semi-skilled workers. The author describes the roller coater and glue spreader similarity, the different

material handling arrangements, the coating of fragile material, instances of temperature control, coating thin steel laminae, channeled coating rolls and localized coating on embossed work. (OF-41)

cf: 42.1.1
Manufacturer:
The Sulzer-Waegner Company

### Dip & Flow Coating

**42.4.1.** Blount discusses the flow coating of range and heater parts. Flow coating is one of the newer techniques employed in recent years. A new installation for finishing various range and heater parts by conveyorized low pressure flow coating has just been completed in the plant of the R.C.A. Estate Appliance Corporation (Ohio). (PF-6)

**42.4.2.** Improved methods, equipment and techniques have been developed for flow coating parts and products safely, effectively, and economically on a mass production basis. Several companies have designed and installed flow coating equipment. (IF-12)

**42.4.3.** Frymire & Fenton describe the flow coating of electric range parts. No comparison is made of the relative merits of high and low pressure flow coating systems. (IF-19)

**42.4.4.** Bardin describes the flow-coating of a food waste disposer at the General Electric Company's Major Appliance Division. The entire system was worked out on a pilot installation in the laboratory of the enamel supplier and uses low pressure flow-coating as the means of paint application. (IF-33)

**42.4.5.** Brenaman describes flow coat priming by Northrop Aircraft, Inc. Every part must be finished in a manner to completely preserve its physical characteristics throughout its service life. No surface corrosion is permissible. The finish coating must act as an impermeable barrier between the part itself and external corrosive influences at all times and under all conditions. Flow coating provides this and has replaced their spray (hand) booths with automatic finishing equipment. (IF-42)

### Aerosol

**42.5.1.** Kester discusses aerosol opportunities for paint manufacturers. During the last 6 years aerosol dispensing of paint has come a long way. The American public has accepted the aerosol application of coatings, and will continue to express its confidence in such products to the degree that improvements are made so that there will be a minimum of disappointment by the consumers. (APJ-50)

**42.5.2.** E. I. du Pont de Nemours & Co., Inc. has issued "The Aerosol Market-Report of 1952 Dealer Survey", a 20-page study of retail distribution practices for aerosol products.

**42.5.3.** E. I. du Pont de Nemours & Co., Inc. has issued "The Aerosol Market-Report of 1953 Consumer Survey", a 28-page study of consumer knowledge, use and opinion of aerosol-packaged products.

**42.5.4.** E. I. du Pont de Nemours & Co., Inc. has issued 32-page brochure "Package for Profit"—information about the expanding aerosol market and the use of Freon safe propellents.

cf: 39.1.46
46.6.2

## CHAPTER 43

# DRYING METHODS

### General

**43.1.1.** Brown describes the force drying of wood finishes. The author discusses the processes involved or included in drying the different finishes on wood—evaporation of solvents, oxidation and polymerization. He discusses the temperatures, humidities, air movement and time periods required in the heat tunnels or ovens to properly force dry these various coatings rapidly, efficiently and economically. (IF-34)

**43.1.2.** Gaynes describes some causes of and several remedies for fouled ovens, in connection with baking paints and finishes on metal surfaces. (IF-46)

**43.1.3.** Johnson presents Part III of his article on getting the most out of metal finishes. The wise selection and use of a bake oven will result not only in better finishes, but also lower operating costs. In this third part, the author discusses the selection and use of ovens. (CPVM-33)

cf: 42.2.18
Manufacturers:
Burdett Mfg. Company
Despatch Oven Company
General Electric Company
George Koch Sons, Inc.
Ovens for Industry, Inc.

### Infra-Red

**43.2.1.** Gas infra-red drying has been developed to the point where various shaped items can be handled by one oven. Walter reviews a number of types of infra-red, gas-fired drying ovens and tunnels. (CPVM-1)

**43.2.2.** Walter discusses the use of gas-fired equipment as a source of infra-red radiant heat. Some of the practices, as used in England and described in this article, are contrary to those in common use in the United States. The following are discussed: fundamentals of heat radiation, source of heat, gas as heating medium, tunnel baking by radiant heat, smaller ovens, factors governing the choice and method of using radiant heating equipment for paint, flux density determines drying time, convection currents and shadows, and articles with varying sections and shielded surfaces. (OF-39)

cf: 42.1.22
Manufacturers:
Burdett Mfg. Company
The Fostoria Pressed Steel Corp.
General Electric Company
Industrial Radiant Heat Corp.
George Koch Sons, Inc.
The Miskella Infra-Red Company
North American Electric Lamps Company
The Op-Al Electric & Mfg. Company
Ovens for Industry, Inc.
Penetray Corp.
Sill Industries
Swenson Associates
The Trippe Mfg. Company

# PRODUCTION TECHNIQUES

# How HYDRITE Kaolinites affect VISCOSITY

## *in Butadiene-Styrene Copolymer Latex Paints*

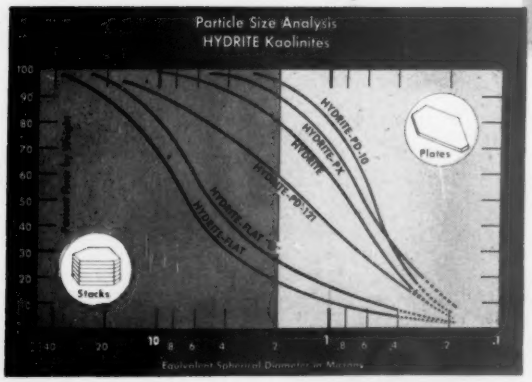
**HYDRITE** Kaolinites help to control viscosity in water-dispersed paint systems.

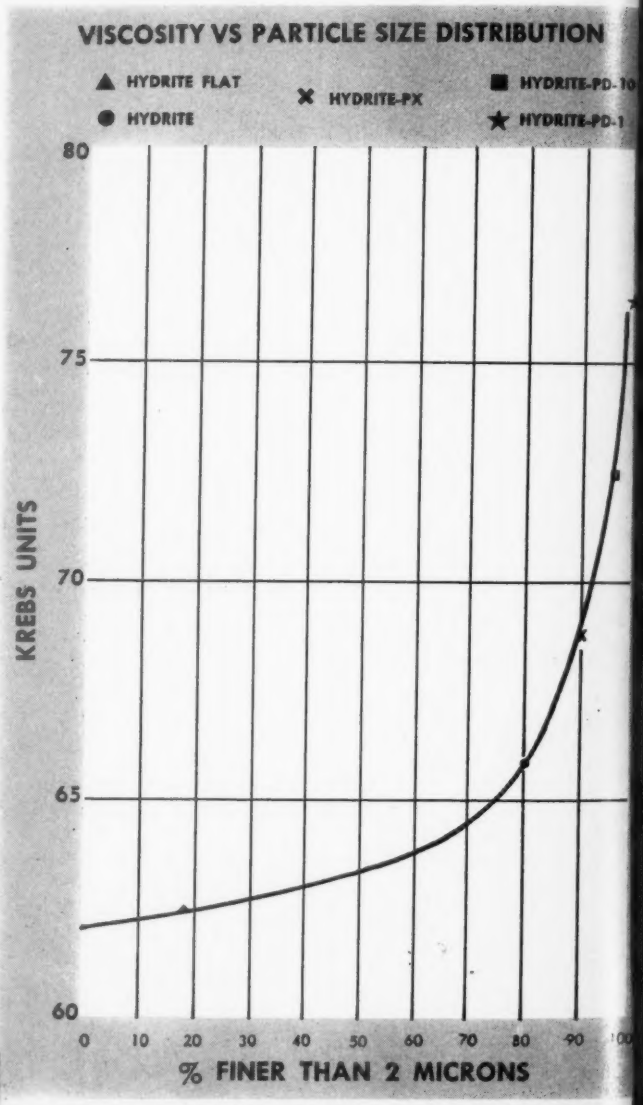
The curve at the right was obtained by using HYDRITE Kaolinites ranging in particle fineness from 4 to 100% finer than 2 microns in a typical butadiene-styrene latex formulation at 45% PVC. Curves at other PVC levels retain the same general shape but are displaced along the vertical axis depending on the amount and type of thickener used and the effective water demand of the kaolinite as influenced by the amount and type of dispersing agents used.

This curve shows why kaolinite may be used as an aid in controlling viscosity. The body imparted by kaolinite is thixotropic in nature, promotes good brushing and levelling characteristics, is not ropy as is that imparted by extenders containing reactive ions, and being of a mineral nature is stable and not subject to chemical or bacteriological degradation.

Further details are given in our Technical Service Bulletin TSBH-11.

***Send for it.***




#4 in a series on the effect of HYDRITE Kaolinites on properties of butadiene-styrene latex paints.

**GEORGIA KAOLIN COMPANY**

435 North Broad Street, Elizabeth, N. J.

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FEBRUARY 15, 1955

# PAINT and VARNISH Production

THE TECHNICAL MAGAZINE FOR MANUFACTURERS OF PAINT, VARNISH, LACQUER AND OTHER SYNTHETIC FINISHES

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## FIVE General Electric plants NOW SERVE THE PAINT INDUSTRY

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Sodium Sulfite

# 1954 REVIEW of the PAINT INDUSTRY

Compiled and Edited by

SAM RUGGERI

IN COLLABORATION WITH THE EDITORIAL STAFF OF PAINT AND VARNISH PRODUCTION

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# PUBLISHER'S MESSAGE

IT is with great pride that we bring to YOU of the paint industry this 1954 Review.

As in previous compilations, every facet of the technical developments which have occurred in the coatings field during 1954 is covered in this Review. Thus, in whatever capacity of the paint field you may be engaged, this Review offers for your benefit the all-important "bird's eye" view of the industry from which you can properly evaluate new developments and trends for direct use in your daily work.

In the interest of improving the value of these compilations, we have expanded this year's Review to include two new and essential features.

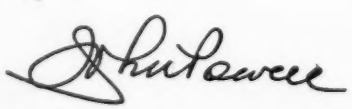
One is a compilation of Government Specifications and specification changes embracing some twenty-five military and federal agencies.

Another feature is the Suppliers' Trade Name Index, which is a compilation of the trade names of raw materials and equipment employed in paint manufacture. A brief description of the item is given together with the name of the supplier or manufacturer. Addresses of suppliers may be found in the Company Index.

We feel confident that the 1954 REVIEW OF THE PAINT INDUSTRY with its new features will, in a great measure, help to make your daily tasks easier by: (1) keeping you advised of new technical developments so that you may be able to give appropriate consideration to new ideas, materials, and techniques; and (2) broadening your background and outlook so that you may be capable of handling greater responsibilities.

We actively solicit your comments, advice, and criticisms so that we can improve subsequent issues of this Review in the years ahead.

By



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# HOW TO USE THIS REVIEW

THIS 1954 REVIEW of the PAINT INDUSTRY, the third in a series, is intended for selective reading and reference on the current developments in the paint industry. When used in conjunction with previous (and subsequent) reviews, the series forms a valuable index to the technical literature and source for information relating to the paint industry.

As illustrated in the Table of Contents, the material is presented in a related pattern. The format used provides 51 chapters; with these chapters being grouped together into 14 sections. The chapters are further sub-divided into various sub-headings, the number varying from one chapter to the next. In evolving this format an attempt was made to provide as many "niches" as necessary to cover the industry thoroughly while keeping the number to a minimum.

There are many ways to use this volume to good advantage. The Table of Contents provides an overall picture of the format as well as providing a reference to the general subjects. A more detailed subject reference is to be found in the Subject Index in the Appendix. An Authors' Index is provided in the Appendix to aid the reader who recalls his information by writer. Both of these indices refer to specific items rather than to the journal references.

Each item reference number is a three digit number such as 30.3.14. The first digit (30) refers to chapter thirty; the second digit (3) refers to sub-heading three; and the last digit (14) refers to the 14th item in this sub-heading.

The specific item refers the reader to the journal reference for further reading. Journal references have been centralized in one place and are found in the Appendix. This permits easier access to the reader, as well as permitting the reader to scan the list of articles for any one journal to select those articles of interest.

Many items come under the scope of more than one heading. Obviously, these items could not be included under all headings. Such articles have been catalogued in one "niche" and cross-referenced under the others. These cross-references, immediately following the last item under each sub-heading within a chapter, should be consulted along with the items for a complete picture of developments within the sub-heading.

Another new feature in this third review has been the inclusion of a list of suppliers at the end of each sub-heading within a chapter. Since this review is aimed at the paint manufacturing industry, this list has not been included in Chapters 38, 39, 40 which cover products of the paint industry. A complete tabulation of the manufacturers listed throughout the body of the volume has been included, together with addresses, in the Appendix.

Finally, a compilation of suppliers' trade names of interest to the paint industry has been included in the Appendix. It is hoped to make this compilation successively more complete with each review as new materials and equipment are introduced from time to time.


THE AUTHOR

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# HIGHLIGHTS

CHAPTER 1

# HIGHLIGHTS

### Introduction

**1.1.1.** The year, 1954, was considered a good year for the paint industry, although total sales did fall slightly short of the 1953 level, which was considered a record year for the industry.

Recent figures released by the Bureau of Census (Dept. of Commerce) show that total sales for 1954 amounted to 1,361,135,000. Comparing this total with 1953, which amounted to 1,402,733,000, we find that 1954 was some 3.0% less than 1953.

One of the most important factors contributing to this slight decrease in paint sales was the result of the "inventory recession" which dominated our national economy during the first half of 1954. This, naturally, caused a curtailment in the use of certain paint products, especially in the industrial field.

However, one of the most encouraging aspects affecting the paint industry is the booming "do-it-yourself" market. It has been estimated that do-it-yourselfers spent approximately $950,000,000 for paints and wallpaper during 1954 and that 70 percent of the interior painting in homes was done by one or more of the family members. Undoubtedly, the popularity of the "do-it-yourself" movement is due, in large measure, to the development of easy-to-apply products in many popular colors and with lack of odor.

A significant development of 1954 occurred in the technology of emulsion paints. In this field, considerable strides were made in the use of latices other than the styrene-butadiene types. The acceptance of polyvinyl acetate emulsion for formulating both interior and exterior finishes by the paint industry has resulted in the availability of this particular latex by many new suppliers. Properties claimed with polyvinyl acetate emulsion paints are quick dry, ease of washability, good adhesion to a variety of surfaces, excellent light stability, and weatherability. One of the reasons for the interest and acceptance of the PVA type of emulsion is the price advantage it has over other types of latices.

Acrylic emulsions also have made their mark in 1954. Paints based on this type of emulsion have been developed also for exterior use and preliminary tests have indicated good results. The main advantages of this type of emulsion are that it can be used on masonry or wood surfaces, and be completely odor free.

To capture their share of the consumer market, manufacturers of the odorless alkyd type paint have made improvements, especially in formulating techniques. Glycerol monoleate has been used with some degree of success in improving the compatibility of alkyds with odorless thinners.

Odorless vehicles based on epoxy resin for formulating flat wall finishes have recently been made available to the paint formulator.

Another interesting product designed for the "do-it-yourself" market was the introduction of thixotropic vehicles. An alkyd combined with small amounts of polyamide resins under certain cooking conditions produces a highly thixotropic body which can be formulated into gelled-type paint. The degree of thixotropy is so great that the introduction of the brush into the can causes the paint to flow, which can be brushed out smoothly without sagging.

Other important materials introduced to the paint industry during the past 12 months include: long oil alkyd for exterior house paints claimed to be non-blistering when properly pigmented; epoxy-alkyd combinations for floor finishes; styrenated-alkyds with fast drying properties; liquid based on butadiene for formulating paints with good resistance to scratching, harsh chemicals, corrosion, etc.; epoxidized oils; silicone vehicle which reduces efflorescence, spalling, cracking in exterior masonry finishes; terpene-based drying oil; line of pulp colors dispersed in water for latex paints (simply stir in latex base without grinding); aluminum paste containing inhibitor to prevent reaction with water; fine particle size silica extenders; and yellow nickel-titanium dioxide pigment; and leaded zinc oxide.

### General

**1.2.1.** Scofield reviewing the developments in the paint industry during 1953, states the outstanding development of the past two years in the field of coatings has been the wide acceptance of latex paints, particularly for interior use. Activity in fire-retardant paints has been high, and there continues to be great interest in the development of more satisfactory and generally applicable coatings for the prevention of corrosion of metals (IEC-2)

**1.2.2.** Cook presents a resume of the 1953 Annual Review of the Paint Industry. This work is a one volume digest of the technical and commercial developments in all phases of the paint industry. The business and government pictures together with new develop-

ments in raw materials, production, formulation, testing, and surface preparation are discussed. (PVP-19)

**1.2.3.** Burrell reviews the 1953 developments in protective coatings. Industry emphasis is on simple, versatile equipment for both the professional and do-it-yourself trade. Trade sales specialties boomed, with aerosol packaged paints leading in popularity and diversification. (CEN-6)

**1.2.4.** Armitage presents part two of a history of paints and varnishes in Great Britain. The author discusses the progress of painting in the medieval period—leading to the formation of the Paynter-Stayners' Guild. He outlines, also, the economic and working conditions of the industry, giving examples of typical costs and prices. (PM-4)

**1.2.5.** Arnold reviews paint technology and the law. While a legal training is not required of the paint technologist, difficulties can frequently be avoided by a broad knowledge of the principal impacts of the law. The technologist should not attempt to be his own lawyer, any more than he would expect to be his own dentist; but he should have some rudimentary knowledge of what may be called legal hygiene. (PM-18)

**1.2.6.** In this second part of the article on paint technology and the law, Arnold deals with flash-point regulations and luminous paint and considers the general effects of the Factories Act on paint technology. (PM-23)

**1.2.7.** Armitage presents part three of a history of paints and varnishes in Great Britain. The author describes the rapid increase in paint raw material imports following the colonization of overseas territories between 1500 and 1700, and discusses the influence of the Statute of Monopolies on the technology of the industry. A review of literature, including contributions to the Royal Society, is also given. (PM-33)

**1.2.8.** Arnold concludes his series of articles on paint technology and the law. He discusses manufacturer's liability under common law and considers contractual obligations and liability in tort-ie. liability for the harm caused to any user by carelessness in the preparation or packing of paint. He concludes with a summary of the information given in the three articles. (PM-35)

**1.2.9.** In the early days of the Royal Society of Arts there were no specialized scientific and technical institutions such as abound today. The Society, celebrating its bicentenary in 1954, thus had a broad interest in science and industry generally and the paint industry was one of many it helped by initiating discussion of new precesses and techniques. To some extent the R.S.A. can be considered a forerunner of modern technical institutions. (PM-40)

**1.2.10.** Kienle, in his Keynote address at the 1953 Annual Meeting of the Federation of Paint and Varnish Production Clubs discussed the Protective Coatings Industry as a practical science. Included were mention of the transition from the trial and error stage to the present scientific industry, influence of demands of the customers and scientific milestones. (OD-16)

**1.2.11.** Armitage describes the development of the paint industry in Great Britain in the 18th Cnetury. That it saw the laying of the foundation of the industry as it is now known is shown by such discoveries as Prussian Blue and the comparatively large number of patents taken out for oils, varnishes and colors. These developments, coupled with increased mechanization, paved the way for the establishment of the modern industry. (PM-45)

**1.2.12.** Sayles discusses organizing for surface coatings research. The goal of every successful research organization should be a well-informed supervisor working with a satisfactory and happy group of research workers. Emphasis should be placed on the following factors to accomplish this:

1. Careful selection of research personnel
2. Pleasant environmental surroundings
3. Fairness in administration
4. Clear-cut delegation of authority
5. Reduction of personnel turnover through incentives
6. Discreet regulation of research personnel
7. Exact definition of research objectives and program
8. Maintenance of high employee morale.

(OD-22)

**1.2.13.** Heiberger discusses the role of petrochemicals in paint. All petrochemicals are the consequence of unique chemical transformations which give rise to intermediates not normally present in crude petroleum. They are produced by:

1. thermal and catalytic cracking
2. dehydrogenation
3. alkylation
4. isomerization
5. polymerization
6. cyclization and aromatization.

Groups covered include products from:

1. paraffin
2. olefins
3. diolefins
4. naphthenic chemicals
5. acetylene
6. aromatics from petroleum
7. miscellaneous intermediates.

(PVP-44)

**1.2.14.** To provide adequate facilities for its expanding program of basic research in the field of surface technology, the Research Division of New York University's College of Engineering has recently established a new Surface Technology Laboratory. Dr. Max Kronstein directs the surface technology program. (PVP-47)

**1.2.15.** Sayles presents the following outline for handling coating complaints:

1. Acknowledge promptly
2. Handle complaints diplomatically
3. Investigate the cause of the complaint
4. Attempt to correct the complaint and satisfy the customer
5. Replace defective merchandise
6. Adopt results from the complaint

(OD-40)

**1.2.16.** Flexible ceramic coatings that can be applied to a wide variety of materials have been developed by Armour Research Foundation. They are not brittle and can be applied to almost any clean solid at a few hundred degrees Fahrenheit. (CEN-23)

**1.2.17.** In the nineteenth century the paint industry began to apply the fundamental advances in chemistry made in the previous

century. Armitage points out the use of formulae based on Dalton's atomic theory and the application of Davey's electrochemical work. These advances, coupled with the publication of more information on the industry, foreshadowed the technical age to come. (PM-62)

**1.2.18.** Renson describes how market research helps industry to evaluate potential markets and thus expand sales profits. Included is the preparation and handling of a survey questionnaire, and the use of the field data. (IR-5)

**1.2.20.** Gardner discusses the "Big Deal" of industrial paint samples. Over 80,000 gallons of paint are shipped annually as paint samples. Here are some questions to consider before sending a sample of paint or finishing material:

1. Are you sure you are contacting the right man?
2. Does he want your sample?
3. Will he give it a fair test soon?
4. Do you know his shop conditions and facilities?
5. And his paint or finish requirements or specifications?
6. Do you feel reasonably sure that the sample of material you are sending will do the job effectively, on the basis of its performance and cost? (IF-44)

**1.2.21.** Fair discusses the requirements for a new paint salesman and for rating his effectiveness. The sole criterium is not "is he selling?" but other aspects such as does he fit into the organization and is he an asset to the organization and these must be considered. (APJ-17)

**1.2.22.** Smith, in Lecture XIX in the Third Ten-Year Practical Paint Course, sponsored by the New England Production Club, discusses the merchandising of paint.

In the selling of any product, four factors contribute to the total sales success. They are, the product itself, its distribution, its merchandising, and its advertising. For total sales effectiveness, each one of these factors must be geared to its maximum efficiency. (APJ-28)

**1.2.23.** Connolly discusses the many aspects of selling in the paint industry. Included are the "Seven Sign Posts of Selling":

1. Always have something new to show
2. Time your calls
3. The presentation is everything
4. Demonstrate
5. Learn to say the right thing
6. Keep a written record of your work—of your calls.
7. Be a nice guy. (APJ-32)

**1.2.24.** Fair discusses how job enthusiasm means more work from employees. As employers must cut corners, shave expenses and get more for the bulk expenditures of his dollars, the question of what he can do to get more work from his present staff is of importance. The creation of greater job enthusiasm is the answer to this problem of getting more work from the employee. (APJ-67)

**1.2.25.** Stevens discusses the "guaranteed annual wage" and how it will affect the paint industry. Three plans are presented and discussed. The guaranteed annual wage seems to be simply an extension of the unemployment insurance program. The whole program should be thoroughly understood before entering into any possible negotiation. (APJ-73)

**1.2.26.** Gray discusses the legality of restrictions against competition. A number of cases are cited involving contracts placing limitations against unfair competition by employees leaving and joining competing organizations.

"Whatever restraint is larger than necessary for the protection of the party, can be of no benefit to either; it can only be oppressive and if oppressive it is in the eye of the law unreasonable. Whatever is injurious to the interests of the public is void on the ground of public policy." (APJ-75)

**1.2.27.** What do you do when you are stuck for an idea? Fair presents a few ideas which should help when working on a problem and looking for an idea to get started. When stuck for an idea, staring out of a window seldom develops anything more than a sizeable headache. How much more valuable is it thumbing through old trade journals, file card indexes or a "tickler file" of ideas. (APJ-77)

**1.2.28.** Whittaker reports paint sales set record in 1953. Topics reviewed are general improvement, new emulsion type sealer, home owner interest, and new plants. (CPVM-20)

**1.2.29.** Zucker discusses patents, copyrights and trade marks. Differences as to acquisition, need for application to government, need for marking, term of monopoly, and scope of monopoly are discussed. Their value to the typical paint company is described. (PIM-15)

**1.2.30.** Singer presents Chapter IX Formation (Part II) of his Fundamentals of Paint, Varnish, and Lacquer Technology. Included are—composition of pigments and vehicles, fineness of pigment, application properties, degree of grind, film properties, cost requirements of specific finishes, manufacturing considerations in formulation, mixing, grinding, cooking oils and varnishes vs buying prepared vehicles and typical method of figuring a formulation. (APJ-77)

# RESINS AND OTHER FILM FORMERS

## CHAPTER 2

# GENERAL RESINS

### General

**2.1.1** Morgan describes the moisture permeability of a wide variety of polymeric film-forming materials, determined at 39.5°C. and a vapor pressure difference across the film equivalent to 53 mm of mercury. The data indicate that most polymers possessing low moisture permeability have:

(1) A saturated or nearly saturated carbon chain

(2) A minimum of chain branching

(3) A high degree of lateral symmetry

(4) A fair degree of longitudinal symmetry

(5) A very high proportion of relatively small, nonhydrophilic substituents. Physical factors, such as orientation and crystallinity, may also contribute to reducing permeability.

Over 100 polymers were examined; of these only 20 had permeabilities below 20 grams of water vapor per 100 m.² per hour at a thickness of 0.002 inch. These included polyethylene, rubber hydrochloride, vinylidene chloride copolymers, polytetrafluoroethylene, polychlorotrifluoroethylene, and isobutylene-isoprene copolymers. (IEC-5)

**2.1.2** Bernhardt studied the effects of ultrasound on pure melts of high polymers. In the ranges of temperatures and frequencies investigated, ultrasonic energy had no depolymerizing effect upon thermoplastic melts. Ultrasound could cause molecular orientation in molten polymer without physical deformation of the polymer. (IEC-51)

**2.1.3.** Hanau reviews the compatibility of polymeric materials. Various phases of the problem of blending several polymeric materials are discussed. The formulator of surface coatings must do a great deal of blending and modifying the various resins and modifiers. Due to the endless possibilities of combinations to be tested, a simplification of the rules governing mutual compatibility is highly desirable. (PVP-29)

**2.1.4.** Synthetic noncyclic all-cis diene polymer closest approach yet to natural rubber molecule. The first such polymer has been prepared at University of Maryland, and the method used in its preparation will permit synthesis of other all-cis diene polymers. (CEN-10)

**2.1.5.** Polyaminotriazoles, condensation polymers developed in the Laboratories of British Celanese show promising possibilities; commercial feasibility is keyed to low-cost hydrazine and sebacic acid. (CEN-11)

**2.1.7.** Thirty or more years ago, the manufacture of paint and varnish was art, pure and simple, and it was performed mostly by practical men ungraced by university degrees. Gradually, this situation changed as paint, oil, and resin chemists began asking fundamental questions about the factors that affect protective coatings. Among the most significant developments has been the creation of an ever-widening range of improved synthetic resins (chronological table included in article). Today, chemists have sufficient knowledge of paint fundamentals so that resin molecules can be tailor-made to meet exacting performance requirements. (CEN-15)

**2.1.8.** Chang & Kummerow found that the autoxidation of ethyl linoleate at 30° C. for 350 hours could be separated into fractions of increasing polarity and molecular weight by extraction with solvent pairs of Skellysolve F and diethyl ether. The analytical results obtained on characterization of the more polar polymer fractions indicated that the oxidative polymers of ethyl linoleate were linked through carbon to oxygen bonds rather than carbon to carbon bonds. This postulation was substantiated by a successful depolymerization of the polymers and the catalytically hydrogenated polymers with HCl, HBr, or HI in aqueous ethyl alcohol. Characterization of the depolymerized product also indicated that the oxidative polymers were joined through carbon to oxygen bonds. (JAOCS-2)

**2.1.9.** Kitchener discusses the progress in colloid chemistry. Colloid chemistry has lost its former aura of mystery, and is rapidly passing from a descriptive into a quantitative science. This change has been made possible partly by the introduction of modern experimental techniques and partly by progress in the fundamental sciences of surfaces and macro-molecules.

The origins of the peculiarly "colloidal" phenomena such as light-scattering, abnormal viscosity, stabilization, coagulation, etc., are well established and can be readily understood in terms of a rational scheme of classification of colloids. Current interest attaches to theoretical attempts to represent these phenomena by quantitative theories, and already encouraging success has been achieved.

The state of progress on some of the principal advancing fronts of colloid science is briefly indicated, in non-mathematical terms. (JOCCA-35)

**2.1.10.** Stone & Burg report on arsine borines and arsinoborine polymers. The methylarsines form borine complexes which are more easily dissociated than the corresponding phosphine borines, but show a similar increase of stability, and difficulty of losing hydrogen, with methylation. The protolytic reactions occur far more readily than those of the phosphine borines, with formation of fairly similar polymers, such as those of the $(CH_3)_2AsBH_2$ unit. (JACS-26)

**2.1.11.** Seymour presents basic criteria for evaluating some plastic materials of construction. Fundamental information about plastic materials as to their generic characteristics is followed by a discussion of the atomic construction of the principle classes of plastic materials. Differences in the chemical resistance of polar and non polar materials are explained. Thirty of the principal plastic materials are considered with respect to their composition, resistance to corrosives, techniques for use, and some of the principal uses of each as structural materials. (C-3)

**2.1.12.** Shepard gives a number of case histories in which experimental or emergency use of plastics as materials of construction has subsequently led to their formal adoption. Principle materials referred to are the various polyester laminates, polyvinylidene chloride and fluorocarbons. The author cites the need for a reliable mondestructive test for the physical properties of reinforced plastics. Accounts are given of successful use of plastics in gas and liquid phase operations involving various corrosives. (C-11)

**2.1.13.** Alexander studied the polymerization of monosilicic acid in 0.1 molar solution at 1.90° over the pH range of about 1 to 6. Below pH 3.2, the degree of polymerization increases linearly with the square root of time. The slope of the polymerization changes above pH 3.2. Also, below pH 3.2 the polymer appears to be relatively homogeneous with regard to molecular weight distribution; above pH 3.2 a hetergeneous distribution is found. At pH 6, monosilicic acid polymerizes almost instantly. The freezing point method was used to determine the number average molecular weight of the polysilicic acid. (JACS-47)

**2.1.14.** Butler & Goette have prepared and characterized eight unsaturated quaternary ammonium bromides and one unsaturated tertiary amine. The quaternary ammonium bromides were polymerized by use of peroxide catalysts, and some of the properties of the polymers determined. It was shown that the double bond of the butene-2 structure did not enter into the polymerization, and that this residual double bond caused a decrease in the basic properties of the resulting polymer. (JACS-50)

**2.1.15.** Patrick & Burton report on polymer production in radiolysis of benzene. Irradiation of liquid benzene with 1.5 Mv. electrons gives polymer as a nonvolatile product with a 100 e.v. yield G ($C_6H_6$—polymer) = 0.75 independent of intensity and total energy input. Average molecular weight increases non-linearly with energy input (max. ca 530). G (double bond formation) decreases linearly with input independent of intensity. (JACS-51)

**2.1.16.** Cairns, et al, report on olefin-carbon monoxide-alcohol copolymers. The radical-initiated copolymerization of ethylene and carbon monoxide in methanol at high pressures gives copolymers containing chemically-bound methanol. The replacement of ethylene by other olefins or of methanol by other alcohols gives analogous copolymers. (JACS-55)

**2.1.17.** Burg & Wagner studied polymeric thioborines, methanethiodiborane and related substances. Present results are consistent with the assumption that methylated sulfur has more electron-donor bonding power than oxygen in similar complexes or polymers, but far less than methylated phosphorus or arsenic. (JACS-57)

**2.1.18.** Tobolsky & Catsiff propose a law of corresponding states for the viscoelastic properties of amorphous polymers in the transition region. Tables are presented from which the modulus-temperature curve (modulus measured after any fixed time t,) can be constructed for many polymers. (JACS-70)

**2.1.19.** Schuur attempts to draw a clearer picture of the mechanism of crystallation. In this article a conception of the mechanism of crystallation is given, on the basis of which, it is suggested the origin of spherulites might be explained. A tentative explanation of several related phenomena is based on the new concept. (JPS-7)

**2.1.20.** Katchalsky and Lifson calculated the electrostatic free energy of randomly kinked, ionized, macromolecules for polyelectrolyte solutions of finite strength. A detailed analysis of the charging process and the reference state of the free energy is given. The mutual electrostatic repulsion of the fixed charges on the macromolecule is the main part of the electrostatic free energy. (JPS-9)

**2.1.21.** Keller proposes a new approach to orientation processes in terms of the morphology of crystalline polymers. The various stages of this process are discussed. Several anomalous and hitherto unexplained orientation effects frequently described in the literature can be accounted for. Preferential tilt of the chains with respect to the fiber axis can now be explained. (JPS-20)

**2.1.22.** Slone & Reinhart measured the properties of 168 samples of commercially available plastics films from 27 manufacturers. The results of tests to determine tensile tear, folding endurance, water absorption, water vapor permeability, low temperature impact, change in linear dimensions on heating, specific gravity and flammability properties are summarized. Materials included

Cellophane
Cellulose Acetate
Cellulose Acetate Butyrate
Cellulose Triacetate
Ethyl Cellulose
Polyethylene
Polystyrene
Polyester
Saran
Polyvinyl Alcohol
" Chloride & Copolymers
Polyvinyl Chloride—Saran laminate
Polymethyl Methacrylate

(MP-27)

**2.1.23.** Sun discusses the effects of atomic radiation on high polymers. Since high polymers are covalent substances, the effect of radiation is largely caused by

ionization and electronic excitation. These processes cause instantaneous flow of electric current and the breakage and rearrangement of chemical bonds, and the formation of free radicals. Consequently, chemical reactions are initiated. The phenomenological results include gas liberation, double-bond formation and elimination, degradation, polymerization, cross linking and vulcanization, vitrification, hydrogenation, and others. As a consequence, many important physical properties are changed.

The implications of atomic radiation are far reaching in their practical respect. Understanding of the deleterious effects has already resulted in development of high polymers that will withstand intense radiation. Studies of beneficial effects indicate that atomic radiation provides to the scientific and technical world a new experimental variable or tool unique in itself. Already, high polymers of better physical or chemical properties are produced that cannot be achieved otherwise. (MP-33)

**2.1.24.** Kirkwood reviews the general theory of irreversible processes in solutions of macromolecules, previously formulated by the author. Applications of the theory to viscoelastic behavior, flow birefringence, and the Kerr effect, and to dielectric dispersion are presented in outline. (JPS-22)

**2.1.25.** Kreussling & Ullman have developed a theory of the excluded volume of branched molecules. The model of the branched molecule is a main or backbone string of beads from which side branches, which are themselves unbranched, originate. Each of these beads has the property of the Kuhn statistical chain element. The calculation is based on the Fokker-Planck equation as used by Hermans and collaborators. The differential equation therefrom is not solved, but the average squared distance between two segments of the main chain is obtained. (JPS-26)

**2.1.26.** Farthing & Reynolds describe the synthesis and properties of a new polyether. 3,3-bis (chloromethyl)—1-oxabutene may be polymerized in the presence of powerful electrophilic catalysts such as boron trifluoride; minute traces of water are also necessary for polymerization to proceed. The resulting-polyether, poly 3,3-bis (chloromethyl)-1-oxabutene, is an inert, highly crystalline and insoluble polymer, m.p. 180°, capable of forming oriented films and fibers. (JPS-41)

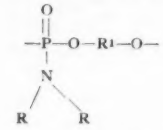
**2.1.27.** Biletch indicates how the physical characteristics of polymers depend on their chemical structure. Steric interaction and polarity are the two principal factors to be considered in tailor-making a linear macromolecule. Present-day theory enables us to predict the physical properties of linear polymers in a semi-quantitative manner. These same general principles apply to the thermoset, cured or cross-linked polymers although only qualitative correlations are possible. Studies of the mechanism of gelation, gel structure and properties will lead to a more accurate analysis and better understanding of cross-linked resins. (IR-7)

**2.1.28.** A process for the production of a fluorescent resinous material which comprises reacting an aryl-substituted alkyl halide with an alkenyl ether of a polyhydroxy organic compound in the presence of an aqueous alkaline medium at condensation reaction conditions. (USP-39)

**2.1.29.** A process for producing a synthetic resin which comprises reacting a carbonyl compound selected from the group consisting of aldehydes and ketones with the condensation product of from about 5 to about 25 mols of a phenol having at least two nuclear hydrogen atoms, from about 25 to about 45 mols of an aromatic hydrocarbon having at least two nuclear hydrogen atoms and an alkyl group of not more than two carbon atoms, and from about 50 to about 75 mols of a conjugated aliphatic diene hydrocarbon. (USP-45)

**2.1.30.** Water-soluble resinous condensation products of at least one aldehyde of the formula RCHO, wherein R is selected from the group consisting of hydrogen and saturated and unsaturated aliphatic hydrocarbon groups containing from one to three carbon atoms and at least one ketone of the formula R'R"CO, wherein each of the substituents R' and R" is an alkyl group wherein R' plus R" is not more than four carbon atoms, containing at least one sulphonic acid group. (USP-1 ))

**2.1.31.** A resinous linear polymeric amidophosphonate comprising the recurring structural unit



wherein R represents a member selected from the group consisting of an alkyl group containing from 1 to 4 carbon atoms, a phenyl group and a cyclohexyl group and $R_1$ represents an aromatic group selected from the group consisting of a phenylene group, a diphenylene group and a diphenylene sulfone group. (USP-143)

**2.1.32.** The method of preparing new monomeric, thermosetting products which comprises heating and agitating, in an inert atmosphere and in the presence of a volatile organic liquid which distills over in form of an azeotropic mixture with water, an $\alpha,\beta$-unsaturated dicarboxylic acid with about the stoichiometric amount of the cyclic adduct of a conjugated diene and a $\beta,\gamma$-unsaturated alcohol, separating the constituents of the distillate from each other, returning the volatile organic liquid to the reaction mixture, and finally removing the agent and any unreacted material. (USP-147)

**2.1.33** The process for producting a resinous reaction product which comprises reacting under aqueous conditions, acetone and formaldehyde with the mole ratio of acetone to formaldehyde being 1 mole of acetone to about 3 to about 5 moles of formaldehyde, said reactants having a strongly alkaline reagent added thereto, said reaction after initiation upon the application of external heat proceeding exothermically due to the addition of a sufficient quantity of said agent thereto, said exothermic reaction reaching temperatures in the range of 160-210° F. the total amount of said agent employed being approximately the alkaline equivalent of sodium hydroxide measuring 1 to 3% of the combined weights of said acetone and formaldehyde when

the mole ratio of acetone to formaldehyde is 1 to 3, 1.5 to 4% of the combined weights of acetone and formaldehyde when the mole ratio of acetone to formaldehyde is 1 to 4, and 2 to 6% of the combined weights of acetone and formaldehyde when the mole ratio of acetone to formaldehyde is 1 to 5, the resinous reaction product produced thereby being thermosetting, measuring by weight at least 75% of the combined weights of acetone and formaldehyde and being soluble in twice its volume of water. (USP-148)

**2.1.34.** The General Electric Company has issued 12-page brochure "GE Serving The Paint Industry", describing various General Electric types of resins for the paint industry.

**2.1.35.** Howard & Sons (Canada) Ltd. has issued 10-page bulletin TS-25 describing properties and uses of Resin MS-2; an alicyclic ketone resin obtained by the condensation of cyclic ketones.

**2.1.36.** Researchers of Imperial Chemical Industries, Ltd. have prepared a polyether by the polymerization of 3,3-bis (chloromethyl) oxacyclobutane.

cf: 39.1.12
50.9.1

**Alkyl Titanates**

**2.2.1** Winter has prepared polymeric butyl esters of titanium by partial hydrolysis of the monomer using various amounts of water dissolved in butanol. The direct preparation of polymeric butyl titanate from titanium tetrachloride, butyl alcohol and water on a pilot plant scale is described. Yields of 80 per cent were obtained.

Hydrolysis is quantitative on addition of up to about 1.5 mol-equivalents of water. On further additions only a portion of the water added enters the reaction. A portion is adsorbed and some remains in the solvent.

Molecular weights of some of the polymers were determined and ranged from 620 to 1400. (JOCCA-13)

**2.2.2** The rates of hydrolysis of monomeric n-butyl, sec-butyl, tert-butyl, n-hexyl, n-octyl, "Alphanol" and "Nonanol" titanium esters as well as those of a number of polymeric n-butyl esters have been determined. Ultimate analyses of some of the hydrolysis products have been made. It is concluded that concurrently with the hydrolysis that takes place on exposure to atmospheric moisture, water is adsorbed by the hydrolytic products. Polymeric butyl titanates prepared by partial hydrolysis employing 1.0-1.5 mols of water have the best film forming properties.

Attempts have been made to explain the variation in the suitability of different pigments by differences in adsorptive activity. Considerable differences in hardness and adhesion have been found in butyl titanate films pigmented with samples of alumina known to differ in adsorptive activity. (JOCCA-14)

**2.2.3.** Method for preparation of alkyl titanates which comprises admixing titanium tetrachloride, an alcohol selected from the group consisting of primary and secondary monohydric non-substituted aliphatic alcohols having at least two carbon atoms, and liquefied ammonia in a closed system said ammonia being present in amount at least equal to that required to react with the chloride ions released from the tetrachloride plus that required to dissolve the ammonium chloride formed by the reaction, and separating the liquid alkyl titanate layer from the liquid ammonia-ammonium chloride layer, the entire process being carried out in the anhydrous state. (USP-43)

cf: 39.7.1
39.7.2

## CHAPTER 3

# ACRYLIC RESINS

### General

**3.1.1.** Spilner gives details on embedding in acrylics. Complete details on the process, from preparation of materials to be embedded to machining the finished casting are given. (MP-7)

**3.1.2.** Feuer and Lynch have prepared unsaturated N-methylolamides, a new class of compounds. The synthesis of N-methylolmethacrylamide, N- methylolacrylamide and N,N′-bis-(methylol)-fumaramide as well as some of their derivatives are reported. Upon heating, N-methylolmethacrylamide and N-methylacrylamide have been converted to infusible polymers which are insoluble in common organic solvents. (JACS-4)

**3.1.3.** Grinsfelder, et al, discuss new acrylic resins for coatings. As a group acrylic resins offer:

1. Water white color and transparency
2. Resistance to discoloration at high temperatures
3. Resistance to water, alcohol, alkali and acid
4. Resistance to mineral oil, vegetable oil and grease
5. Good electrical properties
6. Relatively high resistance to burning
7. Low pigment reactivity
8. Resistance to chemical fumes
9. Good film flexibility and film life (no extractible, migratory, or volatile plasticizer in the film). (OD-37)

**3.1.4.** Electrolytic conductance and transference measurements have been made (Wall & Doremus) on solutions of polyacrylic acid partially neutralized with sodium hydroxide. The fraction of sodium ions bound to polymer ions, the polymer ion mobility, and the polyion transference number all decrease with increase in polymer concentration. The bound sodium fraction remains substantially independent of temperature from 0 to 42°. Substituting potassium for sodium does not alter the bound carbon fraction and polyion mobility. (JACS-39)

**3.1.5.** Ehrlick & Doty prepared and characterized copolymers of methacrylic acid and 2-dimethylaminoethyl methacrylate ranging in composition from 23-57 mole per cent methacrylic acid. It has been found that ionization of the monomers exerts a marked influence on the propagation reactions in methanol, invalidating the application of the two-component copolymerization equation. (JACS-67)

**3.1.6.** Leonard, et al, prepared liquid polymers of ethyl, n-butyl, and 2-ethylhexyl acrylates using an ionic initiating system. Liquid polyethyl acrylate was tested as a plasticizer in a stabilized and unstabilized polyvinyl chloride plastisol composition. In unstabilized composition, fused samples were comparable in color to a DOP plasticized sample. In stabilized composition, a film was obtained showing higher tensile strength yet equivalent ultimate elongation as compared to a DOP plasticized sample. (JPS-17)

**3.1.7.** Morawetz and Gobran studied the osmotic pressure of solutions of mixed acidic and basic polymers. Methyl methacrylate was copolymerized with small amounts of methacrylic acid or dimethylaminoethyl methacrylate. A thermodynanic analysis of the data showed that under certain conditions the activity of one or the other polymer component decreases with increasing concentration of the mixture. (JPS-27)

cf: 2.1.1
16.1.18
18.1.2
18.1.14
34.1.2
36.9.3
49.1.7

Manufacturers:
American Cyanamid Company
E. I. duPont de Nemours & Co., Inc.
Rohm & Haas Company

### Methyl Methacrylate

**3.2.1.** Melville & Watson discuss the polymerization of methyl methacrylate by its polymer. Addition of its polymer causes methyl methacrylate to polymerize. The extent of polymerization is linear with time to at least 5% conversion at 60-90°C. The rate of polymerization is proportional to the first power of the concentration of added polymer and independent of its molecular weight. The molecular weight of the polymer formed increases with increase in reaction temperature. No polymerization caused by polymer occurred with the other polymer/monomer systems tested. The rate and nature of the initiating reaction are discussed. (JPS-2)

cf: 2.1.22
3.1.1
16.1.17
18.1.2
18.1.11
18.1.14
20.2.1
44.2.8
44.2.10

Manufacturers:
E. I. duPont de Nemours & Co., Inc.
Rohm and Haas Company

## CHAPTER 4

# ALKYDS

### General

**4.1.1.** Fitzgerald discusses the deterioration of alkyd resin films by light below 3000°A. The purpose of the investigation discussed was to determine the rate, the geometrical location or site of attack, its approximate relationship to wave length, and its dependence upon oxygen concentration. (IEC-19)

**4.1.2.** This concluding part of the article on the work of the Resins Service Department laboratories of the Dyestuffs Division, I. C. I., on the effect of variations in type and properties of alkyd resin finishes concludes the discussion of gas checking and wrinkling problems and summarizes the results of the work.

One of their conclusions is that cobalt alone gives fairly satisfactory results in some alkyd resin finishes, but when blooming is encountered and the cobalt proportion must be reduced, a lead-cobalt-calcium mixture is the most satisfactory drier mixture yet devised. In particular, good results are obtained with mixtures of 10 parts of lead with 1 part of cobalt and between 5 and 10 parts of calcium. (PM-20)

**4.1.3.** The cohesive mechanical properties of certain alkyd resin pigmented and unpigmented films have been investigated by Snoddon and Carrick. The methods used involved stress-strain and stress relaxation tests on films removed from their substrata. The tests were conducted at constant temperature and humidity.

The paints were prepared in laboratory pebble mills and applied on tin-coated steel panels using a doctor blade technique. After baking, the films were stripped by amalgamating the tin coating.

The mechanical properties of paint films are discussed, and classical theories of viscoelastic behavior are applied to the stress relaxation of the unpigmented material, with good agreement between theory and observed results being obtained using the generalized Maxwell model.

A theory for the increase in stiffness due to the addition of inelastic dispersed spheres to a viscoelastic matrix is applied to the pigmented alkyd film with poor results. The factors causing these deviations are:

1) For any given type of pigment the dispersion of the pigment particles is less than that required by the theory This tends to cause an increase in modulus, or stiffness, over that theoretically predicted. Dispersion also varies with pigment particle size.
2) The pigment-vehicle bond very likely is localized at various areas of the pigment-vehicle interface, as opposed to the assumption that the bond is not localized. This also tends to cause an increase in the modulus over that theoretically indicated.
3) Drier adsorption occurs which lowers the degree of polymerization of the pigmented film compared to that containing no pigment. This tends to lower the modulus below that predicted by the theory. Drier adsorption, being a surface phenomenon, varies with pigment particle size.

For any given type of pigment, the variations in breaking strain are accounted for by these three factors. The cohesive mechanical properties of films containing the different types of pigments differ markedly, due to different pigment surface properties.

The theories of viscoelastic media may be used to study the cohesive mechanical behavior of protective coating films with satisfactory results. (OD-32)

**4.1.4.** Hempel discusses the formulation of short oil alkyd resins with 2.4 mols of glycerine to 3 mols of phthalic anhydride, or 20% excess glycerine over theoretical. Viscosity control was obtained with ethylene glycol, Benthal and larger quantities of excess glycerine. A relationship between the various amounts of these materials to process short oil alkyds to low acid values is presented. Film evaluation of these resins suggests the use of Benthal as the best viscosity control agent. (OD-44)

**4.1.5.** Chipault & McMeans present results of studies on oxidized films of trilinolein and trilinolenin. Previous work has been reported. This present study employed much larger film areas. The films were collected at two levels of oxidation, and after the peroxides has been determined the remainder of the films was reduced and saponified. The hydroxyl, alpha glycollic, and carbonyl content, and the unsaturation of the free acids were then measured. In addition, the neutralization equivalent, molecular weight, and ultraviolet and infrared spectral characteristics of the acids were determined. (OD-48)

**4.1.6.** Rheineck & Brice studied the pinitol & quebrachitol esters of linseed fatty acids. Pinitol &

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quel rachitol esterify with linseed fatt acids at a rate somewhat slow er than glycerol and faster tha inositol. Esterification rates, phy ical, chemical and film properties of the esters of these two cyc tols appear to be identical. The viscosities of the cyclitol est rs are in all cases greater than tho e of pentaerythritol esters at som e degree of polymerization. The cyclitol esters have drying tim s similar to those of the corresponding monopentaerythritol esters and a little slower than those of the dipentaerythritol ester. Film toughness is similar to that of tripentaerythritol esters. Heat bodying of the cyclitol esters reduces their drying speed. (JAOCS-29)

**4.1.7.** Swann & Esposito discuss the analysis of alkyd resins modified with vinyl chloride-acetate copolymer. A method is presented whereby the vinyl is precipitated and the alkyd can then be analyzed. (AC-14)

**4.1.8.** Bragdon discusses glycerine alkyds tailored to need: how the formulator, knowing what he wants the resin to do, can go about making his selection on a sound, practical basis. Included are alkyd resin ingredients, properties imparted by each ingredient, and the selection of the best alkyd for a particular requirement. (APJ-34)

**4.1.9.** Bragdon presents part II of his paper describing glycerine alkyds tailored to need. His discussion includes alkyd processing methods, how solvent cook shortens time, styrenated alkyds, oil length and resin manufacture versus purchase! (APJ-63)

**4.1.10.** An alkyd resin comprising the reaction product of a polybasic carboxylic acid, a polyhydric alcohol, and the copolymerization product of rosin with a monomer of the class consisting of styrene and methyl methacrylate in the presence of a peroxide catalyst and an alkyl mercaptan having at least four carbon atoms, said alkyd resin being compatible with urea-formaldehyde and melamine-formaldehyde resins. (USP-12)

**4.1.11.** A composition of matter comprising a compatible blend of about 10-50 parts of an aminoplast resin selected from the group consisting of melamine-aldehyde resins and urea-aldehyde resins, about 90-50 parts of an alkyd resin modified with 26%-50% by weight of a material selected from the group consisting of semi-drying glyceride oils, nondrying glyceride oils and the fatty acids derived therefrom and 0.5% to 10% by weight of a modifier comprising a polymeric alkyl ester of an alpha, beta unsaturated carboxylic acid. (USP-19)

**4.1.12.** A coating composition, capable of yielding on baking a non-cratering film, comprising a compatible blend of an alkyd resin modified with up to 25% of a material selected from the group consisting of semi-drying and nondrying glyceride oils and their acids, a butylated melamine-formaldehyde resin, and from 0.05% to 10% by weight of a polymeric alkyl ester of an alpha, beta unsaturated carboxylic acid, wherein said percentage by weight is based on the total weight of the resin solids. (USP-22)

**4.1.13.** Ester resins suitable for oleresinous varnish and printing ink formulations which are esters of natural resins of at least 75 acid value with a member of the group consisting of the monomeric monohydric phenolic ethers of aliphatic polyhydric alcohols and their epoxides. (USP-34)

**4.1.14.** The method of forming an alkyd resin comprising simultaneously esterifying and condensing an intermediate product, comprising a monomeric tetrahydrophthalic acid half ester of a monoester of a 10 to 22 carbon atom fatty acid with a polyhydric aliphatic alcohol having at least three hydroxyl groups, with an esterifying agent selected from the group consisting of a 10 to 22 carbon atom fatty acid, a natural resin acid and hydrogenation products thereof, a polycarboxylic organic acid and anhydrides thereof and polyhydric aliphatic alcohols. (USP-40)

**4.1.15.** A process for the production of an improved drying alkyd resin, comprising admixing a drying glyceride oil, modified alkyd resin with from 5 to 60 per cent of its weight of a liquid polymer comprising a polybutadiene free from solid polymers, having a viscosity at 100° F. within the limits of 100 to 10,000 Saybolt Furol seconds, a molecular weight within the limits of 500 to 4,000 and a specific gravity, 60/60° F., within the limits of 0.85 to 0.95, heating the resulting admixture of polymer and drying alkyd resin at a temperature within the limits of 450 and 600°F., whereby said polymer reacts with said alkyd resin to form said improved alkyd drying resin; and recovering said improved alkyd drying resin. (USP-68)

**4.1.16.** A process for effecting the condensation of a member of the class consisting of fumaric acid, fumaric acid anhydride, esters of fumaric acid, half esters of fumaric acid, salts of fumaric acid, salt esters of fumaric acid and amides of fumaric acid with an aliphatic, non-conjugated, polyunsaturated fatty oil which comprises admixing a member of said class with an aliphatic, non-conjugated, poly-unsaturated fatty oil, introducing from 0.1% to about 2% by weight of the mixture of a free halogen, and heating the reaction mass to a temperature within the range of from about 175° C. to 300° C. until said class member has reacted. (USP-124)

**4.1.17.** The Thibaut & Walker Co., Inc. has issued new loose leaf binder containing complete catalog of the various resins and products they manufacture. A good portion of the book is devoted to suggested formulations based on their products.

**4.1.18.** The T. F. Washburn Company has issued a loose leaf binder with technical data sheets, product data, formulations etc., relating to the alkyd and other resins manufactured by them.

**4.1.19.** The Monsanto Chemical Company has issued 90-page book on the "Chemistry and Processing of Alkyd Resins".

cf: 15.1.9
34.2.2
35.10.1
35.10.5
37.2.3
37.3.2
38.1.5
38.1.11
49.1.7

Manufacturers:
Adco Chemical Company
Alkydol
American Alkyd Industries
American Cyanamid Company
Archer-Daniels-Midland Company
Atlas Powder Company
Cargill, Inc.

Farnow Varnish Works
France, Campbell & Darling, Inc.
Freeman Chemical Corp.
General Electric Company
Hercules Powder Company
Jones-Dabney Company
McCloskey Varnish Company
Reichhold Chemicals, Inc.
Rohm and Haas Company
Schenectady Varnish Company
Fred'k. A. Stresen-Reuter, Inc.
The Thibaut & Walker Company, Inc.
T. F. Washburn Company

### Maleic

**4.2.1.** A laboratory study by Brand, et al, of the effect of amount and type of excess polyol on the cooking characteristics and film properties of a maleic-tall oil alkyd has shown that there is a marked effect on vehicle bodying rate, a noticeable effect on storage stability, and slight effect on cold-water resistance. Drying rate and adhesion appear to be essentially unaffected. Excess glycerol over the range from 0 to 25 percent and pentaerythritol from 0 to 10% were studied. Data are presented in graphic form for viscosity development and storage stability. (PVP-36)

cf: 37.2.2
Manufacturers:
Alkydol Labs., Inc.
American Cyanamid Company
Archer-Daniels-Midland Company
Cargill, Inc.
France, Campbell & Darling, Inc.
Hercules Powder Company
Rohm & Haas Company
Schenectady Varnish Company


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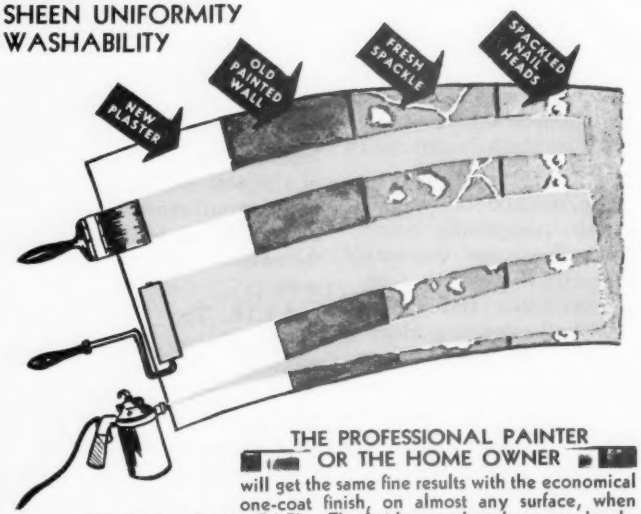


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### Styrenated

**4.3.1.** Hempel discusses the styrenation of alkyd resins. Preparation of a styrenated alkyd may proceed by: 1. Drying oils or fatty acids are reacted with styrene, then treated with phthalic anhydride and glycerine or pentaerythritol, and 2. normally processing the oils, acids and polyols into an alkyd, then up-grading the alkyd with monostyrene. This paper details a suggested procedure for such an esterification and styrenation. (APJ-40)

**4.3.2.** Hempel describes the styrenation of alkyd resins. The largest reason for the growth of styrenated alkyds as new vehicles in surface coatings has been the ease with which alkyd resin equipment could be converted into styrenated processing equipment. Solvent resistance and mar properties of styrenated alkyds have as yet not reached maximum desired degrees, but the growth of styrenated alkyds will continue. (PIM-18)

**4.3.3.** Reichhold Chemicals, Inc. has issued Technical Bulletin SC-7 describing properties and uses of No. 4255-50 Styrasol, an oil-modified alkyd resin combined with vinyl toluene.

cf: 4.1.9
4.1.19
16.1.4
Manufacturers:
American Cyanamid Company
Jones-Dabney Company
Reichhold Chemicals, Inc.

## CHAPTER 5

# CELLULOSE DERIVATIVES

### General

**5.1.1.** Immergut, Ranby & Mark describe recent work on the molecular weight of cellulose. Osmotic molecular weights and intrinsic viscosity of cellulose nitrates and cellulose nitrate fractions in several solvents have been systematically studied. By combination of these results with data on the intrinsic viscosity of the primary celluloses in cupriethylenediamine, a relation is given which permits calculation of the degree of polymerization of cellulose from intrinsic viscosity in cupriethylenediamine. Direct osmotic pressure measurements of solutions of cellulose in cupriethylenediamine were attempted, using polyvinylbutyral and sintered polytrifluorochloroethylene membranes. The shear dependence of the intrinsic viscosity of cellulose nitrates in acetone was studied and the results are presented and discussed. (IEC-9)

**5.1.2.** Martin reports on work of Cellulose Disperse Viscosity Subcommittee. A study of the solvent power and stability of cupriethylene and cuprammonium solvents as a function of the amount of copper and of base has been completed. Work is being started on the preparation of cellulose solutions in the optimum solvents and on the viscosity behavior of such solutions. The Subcommittee is considering a tentative method in which results will be reported in terms of intrinsic viscosity and/or intrinsic fluidity. Factors for converting to degree of polymerization will be included. Viscosity measurements will be made at a concentration such that the product of concentration and intrinsic viscosity equals 3.0. Preliminary data indicate excellent reproducibility at a level within 10% of the true intrinsic viscosity. This tentative method is being tested in several laboratories, but a choice of solvent should be made before a standard method is published. (IEC-11)

**5.1.3.** Immergut & Eirich survey the methods for determining molecular weight with the aid of viscosity measurements. The determination of molecular weights from viscosity data by means of calibration suffers from differences in molecular weight averages and distribution, and from variations of molecular structure. The theoretical interpretation of viscosity data depends on the applicability of the models of molecular shape and rigidity, the state of solution, concentration effects, and the influence of the rate of shear. Experimentally, there are new data concerning the variation of the exponent in the Mark-Houwink relation with molecular weight and solvent. Staudinger's equation is not a limiting law but fits intermediate cases. There is further evidence of a shear dependence of the intrinsic viscosity at high rates of shear or high molecular weights. (IEC-12)

**5.1.4.** Conrad reviews methods for measuring molecular weight uniformity of cellulose and cellulose derivatives. There has been continuous development in methods for measuring molecular weight uniformity. Fractionation methods continue to hold the center of the stage. Recent studies have shown superiority of precipitation fractionation over solution techniques and have emphasized the importance of proper choice of solvent and precipitant. The relative width of the sedimentation diagram and its change with change of distance from the center of rotation are used as a measure of polydispersity, which must be adjusted to zero concentration. New methods include electron microscopy, chromatographic adsorption, turbidity, streaming birefringence, coacervation fractionation, resinographic replica, and dielectric dispersion. Recent methods are concerned with quick approximations for securing the distribution curve, application of automatic or semiautomatic devices for tracing the curve, and improved mathematical techniques for expressing results. (IEC-13)

**5.1.5.** Mueller & Rogers discuss fractionation of cellulose through selective extraction with dilute solutions of cupriethylenediamine (Cuene). A summative method is described in which the sample size or the concentration of the cupriethylenediamine can act as parameter of variation. Only data on concentrations of cellulose and the viscosities of the extracts are required to yield a summative distribution curve, which, following the theory of Coppick and coworkers, can be expanded to the usual integral and differential distribution curves. Results compare favorably with the average of distribution curves for selected standard samples examined by several different methods in cooperating laboratories. (IEC-15)

**5.1.6.** Scott, discussing fractional separation of cellulose reaches the following conclusions. It is futile to subdivide into more than a few fractions per stage. Fractionation is sharper from more dilute solutions, but careful refractionation is more satisfactory than working at dilutions much lower

than 1 gram per liter. A combination precipitation and extraction method is superior to either alone. (IEC-17)

**5.1.7.** Cellulose literature does not exist as such—it is a part of literature of many sciences and technologies. The fact that there is no central organization to plan and prepare annotated bibliographies, together with the tremendous size of the field, accounts for the dearth of such bibliographies in cellulose chemistry. (CEN-9)

**5.1.8.** Chemical Research Activities of Buckeye Cotton Oil's cellulose and specialties division have been transferred to a new laboratory building in Memphis. This building is designed to facilitate basic and applied research on cellulose and protein and their chemical derivatives and by-products. (CEN-13)

**5.1.9.** Weaver, et al, discuss the alkylation of cellulose with esters of p-toluene-sulfonic acid. The topochemical conversion of cellulosic textiles to ethers of cellulose often confers interesting properties. Carboxymethylated fabrics are soluble in alkali, aminoethoxycellulose has the dyeing characteristics of wool, and etherification with the stearamidomethyl group produces a water-repellent textile.

Esters of p-toluenesulfonic acid have been used as alkylating agents for many types of organic compounds, but the literature contains no information concerning the preparation of ethers of cellulose with these reagents.

This preliminary work established the optimum conditions for the methylation of cellulose with methyl p-toluenesulfonate and the alkylation with other esters under these conditions. The reactivity of the p-toluenesulfonates with alkali cellulose was found to diminish as the length of the alkyl group increased. The ethyl and propyl ethers were prepared; but the butyl and phenyl esters were ineffective as etherification agents for cellulose. (IEC-62)

**5.1.10.** Millett, et al, discuss the preparation and properties of hydrocelluloses. The following experimental facts were obtained concerning the heterogeneous hydrolysis of cellulosic materials.

Hydrolysis rates remain constant throughout the hydrolysis of the entire resistant portion.

Average chain lengths decrease rapidly to a relatively low value during the initial stages of hydrolysis and decrease slowly; values of degree of polymerization at the half life are characteristic of each material.

Merceration usually, but not always, increased hydrolysis rates.

Pulping and other procedures applied to a standard cotton have little influence on the leveling-off degree of polymerization, but they do affect the rate of hydrolysis.

Hydrolysis half-life values or hydrolysis rate constants are sensitive characteristics for differentiating wood pulps and for evaluating the influence of pulping and purification procedures.

Curves for moisture adsorption by the hydrocellulose residues as a function of extent of hydrolysis show that moisture adsorption decreases, then increases, and finally reaches a limiting value that is similar for the nine celluloses studied. (IEC-63)

**5.1.11.** Rollins reviews some aspects of microscopy in cellulose research. Included are polarized light, ultraviolet microscopy, infrared microscopy, other special techniques, phase microscopy, experimental results with cotton fibers, studies of the primary wall, winding layer, and other uses of microscopy. (AC-10)

### Cellulose Nitrate

**5.2.1.** The relationship between the viscosity of nitrocellulose and its molecular weight and degree of polymerization is discussed by Caldwell and Creasy and an empirical equation given for calculating these values from determinations of the technical viscosity of nitrocellulose solutions. The effect of the viscosity grade of the nitrocellulose on the viscosity and solids content of lacquers is shown and the development of hot-spray formulations from a consideration of the effect of temperature on nitrocellulose solutions is considered.

The tensile strength and elongation of the various grades of nitrocellulose, both unplasticized and plasticized, and in various solvents, have been determined, showing a marked falling off in the lowest viscosity grades, indicating that low-boiling solvents give greater values than high-boiling solvents.

These properties have been compared with natural weathering and cold check tests, and it has been found that the same trend is followed; the durability is independent of the nitrogen content or of the source of the cellulose whether cotton linters or woodpulp. The moisture permeability is shown to be practically independent of the viscosity and nitrogen content but is decreased by plasticizers.

The relative advantages and disadvantages of nitrocellulose made from cotton linters and dense woodpulp are indicated. (JOCCA-20)

**5.2.2.** The degree of nitration of nitrocellulose of a given molecular weight has an important effect upon the viscosity of its solutions. As complete nitration is seldom attained, this effect must be considered in determining degree of polymerization from viscosity measurements. Lindsley & Frank present an equation which makes it possible to calculate the intrinsic viscosity of any nitrocellulose, independent of the nitrogen content. (IEC-10)

**5.2.3.** Nitration and fractionation of cellulose are discussed by Roseveare & Poore. Difficulties not anticipated from the literature were encountered in the fractionation of nitrated cellulose. The results of this work show the effects of nitrating procedure on the quality of the nitrocellulose. Sources of error in fractionation and the degree of separation of one- and two-step fractionations are given. These results will help others prepare stable, undegraded nitrocelluloses and recognize some of the difficulties and limitations of fractionation in giving true degree of polymerization distributions. (IEC-14)

**5.2.4.** Mitchell presents report of Subcommittee 21, Committee on Standards and Methods of Testing, Division of Cellulose Chemistry, American Chemical Society on precipitation fractionation of cellulose nitrate. Towards selecting a method for the determination of molecular weight distribution of cellulose, 17 laboratories have applied their preferred fractionation procedures to six standard celluloses. A majority preference was shown for "precipita-

tion" fractionation of the cellulose nitrate derivative, prepared with minimum degradation. A tentative method involves: (1) conversion of the cellulose to cellulose nitrate, (2) separation into several fractions through stepwise precipitation from solution by the addition of a nonsolvent, and (3) measurement of the weight and viscosity of each recovered fraction and calculation of its average chain length. (IEC-16)

**5.2.5.** Bruxelles & Mahlman point out the complex nature of what is called glossiness in nitrocellulose lacquers and the properties of a surface that affect it. It is believed that the use of surface traces, or coating profiles, is a promising tool in the study of protective coatings. The use of such data permits an evaluation of a physical surface obtained, and this surface is probably the most important of the many independent and interrelated gloss variables.

The measurement of coating profiles has demonstrated the close surface correlation of topcoat and substrate, and points the way to improved coating design. (OD-36)

**5.2.6.** Flory, et al, studied the thermodynamics of crystallization in cellulose trinitrate. The high melting point of cellulose trinitrate is a consequence of its low entropy of fusion, and cannot be attributed to large intermolecular attractions in crystals. (JPS-24)

cf: 5.1.1
5.1.4
5.4.1
20.2.1
39.1.24
39.1.25
50.5.3

Manufacturers:
American Cyanamid Company
Hercules Powder Company
Monsanto Chemical Company

### Cellulose Acetate

**5.3.1.** Malm, et al, discuss the effect of salts in purification of cellulose prior to acetylation. Various salts in the final wash water used in the purification of cellulose affect acetylation reactivity. (IEC-4)

cf: 2.1.22
4.1.7
5.1.4
5.4.1
8.6.5
17.1.12
20.2.1
50.3.5

Manufacturers:
Eastman Chemical Products, Inc.
Hercules Powder Company

### Cellulose Acetate Butyrate

**5.4.1.** Gearhart & Ball present part II of their series on half-second cellulose acetate butyrate. The purpose of this paper is to elaborate on previously presented data on this cellulose mixed ester and to present more information about this material. The information includes a comparison of the product with other cellulose acetate butyrates, with cellulose acetate, and with cellulose nitrate; modification with plasticizers, solvents, resins, and pigments; and finally some typical formulations for lacquers and melt coatings. (OD-33)

**5.4.2.** An organic, resinous, transparent, flame-resistant, thermoplastic composition consisting essentially of 50-75% of cellulose acetate butyrate combined with 22-35% of chlorinated paraffin wax containing from 64% to 68% of chemically combined chlorine, and an organic stabilizer for said chlorinated paraffin wax to make in all substantially 100%, said stabilizer being an epoxy compound. (USP-131)

**5.4.3.** Eastman Chemical Products, Inc. has issued 24-page booklet—Technical Data on Half-Second Butyrate Lacquer. Also issued were Formulator's Notes Nos. 2-5 listing formulations for paper lacquer, clear metal lacquer, aluminum foil lacquer, and hot melt coating.

cf: 2.1.22
Manufacturer:
Eastman Chemical Products, Inc.

### Ethyl Cellulose

**5.5.1.** The Hercules Powder Company has issued 16-page brochure describing properties and use of ethyl cellulose in specialty coatings.

cf: 2.1.22
20.2.1
39.1.24
39.1.25
39.1.46

Manufacturers:
Dow Chemical Company
Hercules Powder Co.

### Carboxymethylcellulose

**5.6.1.** Dieckman, Jarrell and Voris discuss carboxymethylcellulose in the free acid form; preparation and properties of water dispersions. A water dispersion of the acid form is prepared by acidification of a water solution of sodium carboxymethylcellulose with a strong acid-type cation-exchange resin. Viscosity data for water dispersions are given. (IEC-3)

**5.6.2.** Allgen & Roswall studied dielectrically by the "ellipsoid method" at various wave lengths, a carboxymethylcellulose sodium salt (CMC) with about 50% of the glucose units substituted. Aqueous solutions containing 0.1—0.0025 g/100 ml were investigated. Dielectric increments of 2-9 dielectric constant units were obtained for these solutions. It was concluded that the dielectric properties of CMC are very similar to those of other polyelectrolytes studied—such as desoxyribonucleic acid, nucleohistone, and hyaluronic acid. (JPS-30)

**5.6.3.** Nieuwenhuis studied the improvement of the dirt suspending power of CMC. The salts of carboxymethylcellulose (CMC) are used in large quantities to improve the dirt-suspending power of synthetic detergents and soaps. Hardly any attention has been given to the question as to which properties they should have to obtain the greatest suspending power. (JPS-31)

**5.6.4.** A water-soluble plastic film consisting of 100 parts of a water-soluble salt of carboxymethylcellulose containing at least 0.3 glycollic acid residues per glucose unit of cellulose and 30-100 parts plasticizer, said plasticizer consisting of 35-65% glycerine and the balance sorbitol. (USP-83)

**5.6.5.** The Hercules Powder Company has issued 16-page booklet "Hercules CMC on Paperboard for Better Gloss Printing."

**5.6.6.** CMC-CT—new applications for technical grade sodium carboxymethyl cellulose are contained in a revised booklet from Hercules Powder Company.

Manufacturers:
Hercules Powder Company
Wyandotte Chemicals Corporation

### Methylcellulose

**5.7.** (No abstracts) American Cyanamic Co.

Manufacturer:
Dow Chemical Company

### Hydroxyethylcellulose

**5.8.1.** A new powder form of Cellosize hydroxyethylcellulose is now being offered by Carbide and Carbon Chemicals Company. It's available in two viscosity types—WPHS and WPHS Low.

Manufacturer:
Carbide & Carbon Chemicals Division

## CHAPTER 6

# EPOXY RESINS

### General

**6.1.1.** Dearborn and others studied the reaction between polyglycidyl ethers and carboxylic acid anhydrides, using the thermal yield point as the significant variable. The yield point increases with increasing anhydride content of the molding compound to a maximum which corresponds to a ratio of one mole of anhydride to one mole of epoxy-oxygen. Amines were found to accelerate the reaction markedly. A large number of compositions were investigated. Increasing the functionality of the glycidyl ether and/or that of the anhydride increases the thermal yield point. (IEC-24)

**6.1.2.** Rouse, et al, studied curing agents for epoxy resins. The study was designed to evaluate a series of cured coatings based on epoxy resins, including both air-dried and baked coatings.

Probably the best over-all coatings, based on epoxy resins, are obtained when urea or phenolic resins are used as curing agents. These systems, however; unlike those containing aliphatic amines or polyamide resins, require elevated curing temperatures.

Epoxy resin esters, cured either by oxidative or heat polymerization, provide films with good gloss and color retention as well as with flexibility and solvent resistance superior to that shown by alkyd films.

Epoxy resin compositions employing polyfunctional amines as curing agents may be either air-dried or baked. Threshold baking temperatures are low, compared to systems employing phenolic or urea resins. These compositions, cured at room temperature, are superior to alkyds and to epoxy resin esters from the points of view of solvent and chemical resistance, and hardness. They are inferior in color and gloss retention.

This study shows that polyamide resins, are highly effective for achieving cured compositions in combination with epoxy resins. Such compositions, like those containing aliphatic amines, may be cured by air-drying or by baking at low temperatures. Epoxy-polyamide compositions show better flexibility, greater impact resistance, somewhat better blush resistance, better gloss retention, and not as good initial gloss as the epoxy-aliphatic amine system. (OD-13)

**6.1.3.** "Curing Agents for Epoxy Resins" presented at the Annual Meeting of the Federation of Paint & Varnish Production Club in Atlantic City, N. J., October 29, 1953 by the Northwestern Paint & Varnish Production Club was also presented before the Northwestern Club prior to presentation at Atlantic City. This paper (previously abstracted, See 6.1.2.) was followed by an open forum discussion at the Northwestern Club. (OD-28)

**6.1.4.** Cerami reviews the epoxy resins. The growing attention being focused on the epoxy group of resin finishes is based, in large part, on their extraordinary versatility. By combining them with various materials-urea resins, phenolic resins or fatty acids, among others—a whole range of air-drying and baking vehicles can be produced. (OF-16)

**6.1.5.** Shell Chemical turns out epoxy resins at record rate; annual U.S. output may soon hit 30 million pounds. Highly flexible paints based on epoxy resins have become preferred products in the meta decorating field-coatings are applied before stamping operations. Excellent abrasion resistance has led to their increasing use for floor varnishes; resistance to chemical attack has made them a premium product for industrial maintenance coatings. (CEN-18)

**6.1.6.** Hopper reviews the uses of Epon resins in surface coatings. Epon resins can be used in three basic ways as surface coatings: (1) as heat-converted films with urea or phenolic resins, (2) as ester combinations with fatty acids, and (3) as films converted either at room temperature or elevated temperatures with chemical amines DTA, EDA, etc., or with certain amides like the polyamide resins. These three basic systems are discussed in detail. (OD-49)

**6.1.7.** Delmonte discusses the use of epoxy resins for laminated tooling. Their low shrinkage and good adhesion are solving many of the problems inherent in production and use of plastic tools in metal working industries. The author discusses the selection and use of epoxy resins, their pot life and cure, and other considerations in their use. (MM-10)

**6.1.8.** Aries discusses the use of epoxy casting resins for embedding electronic components. (MP-31)

**6.1.9.** The Northwestern Club studied curing agents for epoxy resins. Epoxy resins cure by the following five procedures:

1. Cross-linking with urea and/or melamine resins at elevated temperatures.
2. Cross-linking with phenolic resins at elevated temperatures

3. with aliphatic polyfunctional amines such as ethylene diamine and diethylene triamine
4. esterified with various vegetable oils and esters cured by oxidation
5. with monomeric acids or acid progenitors such as p-toluenesulfonic acid or phthalic anhydride

In this study all methods were included except for acid-cured systems. (POCR-8)

**6.1.10.** Seymour & Steiner discuss epoxys for cements and coatings. Although the proper role of epoxy cements is yet to be firmly set, their properties leave no doubt about their potential usefulness in corrosive applications. (CE-18)

**6.1.11.** Hopper discusses the use of Epon resins in surface coatings. These resins can be used in three basic ways, 1. as heat converted films with urea or phenolic resins, 2. as ester combinations with fatty esters, and, 3. as films converted either at room temperature or elevated temperatures with chemical amines—DTA, EDA, etc., or with certain amides like the polyamide resins. These three basic systems are discussed in detail. (APJ-72)

**6.1.12.** Jorczak & Divorkin discuss epoxy-polysulfide resins. The combination of polysulfides with epoxy resins result in flexible thermosetting plastics. High degree of impact and chemical resistance, low shrinkage, and good adhesion to metals and non-metals are major advantages. (PE-5)

**6.1.13.** Hopper discusses the use of Epon resins in surface coatings. They can be used in three basic ways as surface coatings: 1. as heat converted films with urea or phenolic resins; 2. as ester combinations with fatty acids; 3. as films converted either at room temperature or elevated temperatures with chemical amines—DTA, EDA, etc., or with certain amides like the polyamide resins. These three basic systems are discussed in detail. (POCR-33)

**6.1.14.** Hopper discusses the use of Epon Resins in surface coatings. These epoxy resins can be used as heat converted films with urea or phenolic resins, as ester combinations with fatty acids, or as films converted either at room temperature or elevated temperatures with chemical amines. (PIM-26)

**6.1.15.** The two step process of making high melting point resins and final infusible products which comprises first reacting a dihydricphenol free from reactive groups other than phenolic hydroxyl groups with an excess of an aliphatic polyepoxide free from reactive groups other than epoxide and alcoholic hydroxyl groups to form a reaction product having terminal epoxide groups and further reacting this product with a further amount of such a dihydricphenol. (USP-91)

**6.1.16.** A composition comprising an epoxidized carboxylic acid ester containing a plurality of non-terminal epoxy groups in the acyl groups thereof in admixture with glycidyl polyether of a polyhydric phenol having a 1,2-epoxy equivalency greater than 1.0. (USP-140)

**6.1.17.** The Bakelite Company has issued Technical Bulletins Nos 1-3 on Bakelite C-8 Resins:

BR-18774 high viscosity epoxy resin

BR-18795 low viscosity epoxy resin

BR-18794 relatively high viscosity epoxy resin.

**6.1.18.** Reichhold Chemicals, Inc. has issued Technical Bulletin SC-5 describing properties and uses of P-786-50 Beckosol, an ester made from an epoxy resin and dehydrated castor oil fatty acids.

**6.1.19.** The Shell Chemical Corporation has issued Bulletin SC: 54-30 "Chemical Resistant Baking Vehicle Epon Resin Formulation YP-100.

**6.1.20.** The Shell Chemical Corporation has issued Bulletin SC:54-37 #Bibliography of Magazine Articles for Epoxy Resins".

One hundred references are cited dating from 1946 to date of issue.

**6.1.21.** The Shell Chemical Corporation has issued Bulletin SC:54-47 on "The Use of Epon Resins in Adhesives Applications."

cf: 13.1.1
13.1.10
13.2.2
14.1.5
39.3.24
39.12.6

Manufacturers:
Aries Laboratories
Bakelite Company
Ciba Company, Inc.
Furane Plastics Inc.
Jones-Dabney Company
Schenectady Varnish Company
Shell Chemical Corp.

### Styrenated Epoxy Resins

**6.2.1.** Tess, et al, report on styrenated esters of bisphenol-epichlororhydrin condensates: A solvent method of styrenation allows all of the styrene to combine with the esters. The styrenated esters of bisphenol-epichlorohydrin condensates possess an unusual combination of properties that should prove useful in commercial coating applications. (IEC-39)

cf: 16.1.4

## CHAPTER 7

# HALOGEN---CONTAINING RESINS

### General

**7.1.1.** Reding & Brown studied the cause of the brittleness of polychlorotrifluoroethylene, which results when the resin is slowly cooled from the melt or heated for prolonged periods at a temperature slightly below the melting point.

The polymer chains in the spherulites of fluorothene are oriented to produce cleavage planes parallel to the spherulite radii. The spherulites form regions of weakness in the polymer. Size and perfection of spherulites are corrulated to the brittleness and voltage breakdown of the polymer. To minimize these undesirable properties, the size and perfection of the spherulites must be minimized. (IEC-84)

**7.1.2.** A liquid coating composition comprising an aqueous dispersion of polytetrafluoroethylene containing a wetting agent and an aqueous dispersion of another resinous polymerized ethylenically unsaturated material, the second mentioned aqueous dispersion and said coating composition each having the property of drying at a temperature of at least 100°C. in one coat to a crack-free film having a thickness greater than the critical cracking thickness of said aqueous dispersion of polytetrafluoroethylene alone. (USP-137)

**7.1.3.** A composition resistant to the discoloring effects of heat comprising 100 parts by weight of a halogen-containing resin and as a stabilizer therefor a mixture of 0.05 to 2 parts by weight of a zinc salt from the group consisting of zinc salts of organic acids and zinc salts of inorganic acids which give a non-acidic reaction in an aqueous medium and 1 to 10 parts by weight of a calcium chelate derivative of a 1,3-dicarbonylic compound capable of keto-enol tautomerism, the quantity of said zinc salt being smaller than the quantity of the said calcium chelate. (USP-157)

cf: 2.1.12

### Chlorinated Rubber

**7.2** (No abstracts)

cf: 39.1.24
39.1.25
49.1.7

Manufacturer:
Hercules Powder Company

### Chlorinated Polyphenyls

**7.3.** (No abstracts)

cf: 20.1.6

Manufacturer:
Monsanto Chemical Company

### Chlorinated Paraffin

**7.4.** (No abstracts)

Manufacturers:
Diamond Alkali Company
Hercules Powder Company

CHAPTER 8

# HYDROCARBON RESINS

### General

**8.1.1.** Snyder, et al, describe a technique for the separation of substantial quantities of the labile trans-1-cyano-1, 3-butadiene from its cis isomer. Melting point data and infrared spectra determinations have confirmed the assignments of configeration previously given to these isomers. The cis compound copolymerized with butadiene about 2.5 times more rapidly than the trans isomer. When various mixtures of the isomeric cyanodienes were copolymerized with butadiene, it was found that at any given percentage conversion, the composition of the copolymer was independent of the cis-trans ratio in the monomer charge. Moreover, the geometrical configurations and elastomeric properties of copolymers from the two isomers were practically identical. It was concluded that both isomers have identical monomer reactivity ratios with butadiene, but that inhibitors of copolymerization were engendered during copolymerizations involving the trans isomer. The Diels-Alder adducts of the trans isomer with itself and with butadiene were shown to be powerful polymerization inhibitors. (JACS-1)

**8.1.2.** Melalia and Freedman determined the configuration of polybutadienes prepared at high temperatures. Solution polymerization of butadiene-1,3 was carried out at various temperatures, using propylene carbonate as solvent and di-t-butyl peroxide as initiator. The polymers were dissolved in carbon disulfide and analyzed for cis, trans and 1, 2-addition by infrared absorption. The instrument was calibrated using reference standards of polybutadiene prepared at 5 and 97°. As the temperature was increased beyond 100°, the % cis increased very gradually and finally leveled off to a constant value, of about 30% cis over the temperature range 180 to 270°. (JACS-3)

**8.1.3.** Krigbaum and Flory present the evaluation of thermodynamic interaction parameters from dilute solution measurements. This is part V of Statistical Mechanics of Dilute Polymer Solutions. Accurate osmotic pressure measurements are reported for benzene solutions of four well-fractionated polyisobutylene samples, varying in molecular weight from 102,000 to 720,000, at three temperatures in the vicinity of the $\Theta$ temperature at which the second virial coefficient in the expansion of the osmotic pressure vanishes. As evaluated from these data, $\Theta = 297.5°$ K., independent of the molecular weight. The entropy of dilution parameter $\Psi$, calculated from the change in the second virial coefficient with temperature at $T = \Theta$, is $0.34 \pm 0.02$. (JACS-8)

**8.1.4.** Naylor & Anderson studied the thermal stability of copolymers of $SO_2$ with ethylene, propylene, butene-2, isobutene and butadiene. Degradation of all but butadiene $SO_2$ follow first-order kinetics to a first approximation at 200° or above. (JACS-69)

**8.1.5.** Leeper & Schlesinger studied the interconversion of alpha and beta forms of gutta polyisoprene obtained from chicle. The gutta isolated from chicle was shown to be structurally identical with the trans-polyisoprene from gutta percha and balata but has a molecular weight of 16,000-18,000, about half of that of the latter two polymers. The $\alpha$- and $\beta$-forms of chicle gutta were prepared and studied. (JPS-3)

**8.1.6.** Having a structure very similar to natural rubber, new resin (Solarite Resin #11) blends easily with both natural and synthetic rubbers, maintaining flexibility even after severe aging. (CE-9)

**8.1.7.** Bisschops studied the reversible gelation of concentrated polyacrylonitrile solutions, by creep measurements under constant shearing stress at different stages of the reaction. The rate of gelation increased strongly as the temperature decreased. The gelation is ascribed to the formation of a tri-dimensional network. The cross-links are assumed to be crystallization nuclei. (JPS-44)

**8.1.8.** A water-insoluble resin containing a plurality of sulfonic acid groups, said groups being attached to an insoluble, infusible resin prepared by the polymerization of a polymerizable mass comprising a polymerizable aryl acetylene hydrocarbon compound. (USP-5)

**8.1.9.** A new composition of matter adapted to be formed into shaped articles, comprising at least 5 percent of an acrylonitrile polymer containing, by weight in the polymer molecule, at least 80 percent of acrylonitrile, an organic solvent for the polymer, and from 0.1 to 5.0 percent based on the weight of the organic solvent of an inorganic acid salt of an organic amine selected from the group consisting of hydroxylamine hydrochloride, dimethylamine hydrochloride, phenylhydrazine hydrochloride, and aniline sulfate. (USP-101)

**8.1.10.** A process for the preparation of a resinous polymer which comprises mixing butadiene, isobutylene and toluene in a ratio of 60/20/20, diluting the mixture with methyl chloride, cooling the diluted solution to a temperature between 0° C. and—40°C., adding thereto 10% by weight based on the feed of aluminum chloride catalyst dissolved in ethyl chloride in a concentration between 0.1 and 5% and separating the resulting resin from the reaction mixture. (USP-117)

**8.1.11.** A new synthetic rubber processing resin is now being made by Solar Compounds Corp. Known as Solarite Resin No. 11, it's a synthetic hydrocarbon resin.

cf: 18.1.12
50.1.1
Manufacturers:
Advance Solvents & Chemical Corp.
American Mineral Spirits Company
The R. J. Brown Company
Enjay Company, Inc.
Neville Chemical Company
Pan American Chemicals
Pennsylvania Industrial Chemical Corp.
Petroleum Specialties Company
Solar Compounds Corp.
Velsicol Corp.

The Goodyear Tire & Rubber Co., Inc.
Indoil Chemical Company
Nova Chemical Corp.
Oronite Chemical Co.
Thiokol Corp.

### Coumarone-Indene

**8.2.** (No abstracts)

Manufacturers:
Barrett Division
Neville Chemical Company.
Pennsylvania Industrial Chemical Corp.

### Petroleum Hydrocarbon

**8.3.1.** Panek, et al, discuss air drying polysulfide rubber paint films. These films have a unique property, namely a negative coefficient of electrical resistance versus elongation. (POCR-10)

**8.3.2.** The Pennsylvania Industrial Chemical Corporation has issued 4-page bulletin on properties and uses of Transphalt, a series of dark thermoplastic resins.

**8.3.3.** The Petroleum Specialties Company has issued 10-page technical bulletin describing properties and uses of Petro-Resins #76, 90, and 100, polymerized olefinic hydrocarbons.

cf: 50.5.3

### Terpenes

**8.4.** (No abstracts)

Manufacturers
Hercules Powder Company
Pennsylvania Industrial Chemical Corp.

### Butadiene-Styrene Resins

**8.5.1.** The polybutadienes and butadiene-styrene copolymers were prepared by Binder, to study the effect of recipe variables on the physical properties and to learn whether there are correlations between the microstructures and physical properties. The changes in microstructure of emulsion polybutadienes and butadiene-styrene copolymers of the types studied, which can be produced by either recipe variables or changes in temperature, are limited. (IEC-79)

**8.5.2.** Polson discusses styrene butadiene copolymers in the paint industry. The styrene-butadiene copolymer resins have been proven excellent paint vehicles. In the United States they have received recognition as standard raw materials of the paint industry. Paints based on them may be readily formulated and produced in equipment now existing in paint factories. The paints produced have outstanding resistance to chemicals and have been shown to possess excellent exterior durability. The technology of the formulation and manufacture of these paints is well developed. Markets for these paints are growing and present markets

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have not yet been fully exploited. (OD-47)

**8.5.3.** Goodyear's technique for synthetic resins now successfully developed to plant scale. Unique process removes water, during butadiene-styrene polymer production, without evaporation or mechanical means. Done by syneresis, ie; sweating or squeezing out of the solvent as a separate phase from a thixotropic gel. (CE-23)

**8.5.4.** The Goodyear Chemical Division has issued a revised copy of 16-page brochure Stucco Finishes made with Pliolite S-5, butadiene-styrene resin.

**8.5.5.** The Marbon Corporation has issued a loose leaf binder with ten technical reports on the properties and use of Marbon 9200, a styrene copolymer resin.

Manufacturers:
Dewey & Almy Chemical Company
The Goodyear Tire & Rubber Co., Inc.
Marbon Corp.
West Virginia Pulp & Paper Company

**Asphalt And Other Bitumens**

**8.6.1** Shearon & Hoiberg discuss the air-blowing of asphalts and catalyst additions to modify blown asphalts. Catalyst addition, as for example phosphorus pentoxide, prior to blowing results in modified blown asphalts having greater flexibility at low temperatures and increased resistance to flow at high temperatures. Product characteristics vary with quantity of catalyst and blowing time. (IEC-1)

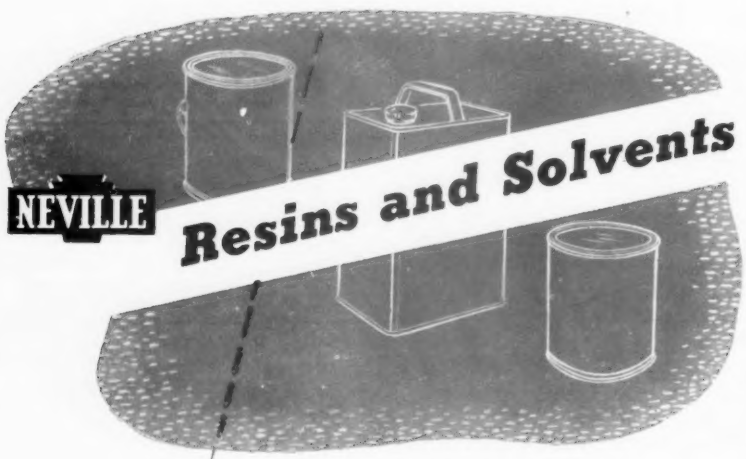
**8.6.2** Greenfeld discusses accelerated tests on three asphalts, representative of the major sources of coating asphalt used in the manufacture of prepared roofings in the United States. Thermal shock tests were compared with "Weather-Ometer" tests. (ASTM-2)

**8.6.3** Greenfeld describes the use of a hydraulic press to the preparation of uniform films of both stabilized and unstabilized bitumens for exposure out of doors and to accelerated durability tests. Films in the range of 0.005 to 0.050 in. were made consistently with a maximum variation of ±0.001 in. in more than 90% of the cases. Coatings up to 0.100 in. thick can also be made. (ASTM-3)

**8.6.4** Kleinschmidt describes a method for the preparation of test coatings by spinning of asphalts, coal-tar pitches, and other solid materials not having fixed melting points, and which will liquify under 450°F. The method was most effective where a series of coatings was required varying by small increments in thickness. Coatings have been prepared by this method from blown petroleum asphalts in thicknesses ranging from 0.0005 to 0.05 in. (ASTM-4)

**8.6.5.** Salomon, et al, have adapted the method of van Heurn and Begheyn, to the estimation of rubber in asphalt. As a corollary to the growing tendency to add elastomers to bitumen and asphalt, a method by which these polymers can be estimated quantitatively in mixtures is needed. The rubber is extracted with xylene or higher boiling solvents. The rubber in this soluble portion then reacts with a large quantity of sulfur and the rubber content is determined from a sulfur analysis of the purified ebonite. (AC-1)

**8.6.6.** A self extinguishing asphalt composition comprising a mixture of asphalt, chlorinated paraffin in the range 5-40%, and antimony oxide in the range of 5-40%, the combined weight of the chlorinated paraffin and antimony oxide being in the range of 25%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*Plants at Neville Island, Pa., and Anaheim, Cal.*

P-52

to 100% of the asphalt, the chlorinated paraffin being at least 50% chlorinated, and the balance being substantially inorganic filler. (USP-80)

cf: 3.2.2

Allied Asphalt & Mineral Corp.
Anderson-Prichard Oil Company
Barber Asphalt Corp.
Barrett Division
Newport Industries, Inc.
Pennsylvania Industrial Chemical Corp.
G. S. Ziegler & Company

**Butadiene-Acrylonitrile Resins**

**8.7.1.** The reactions of acrylonitrile and butadiene in the temperature region of 400° and atmospheric pressure are reported by Janz and Duncan. In the uncatalyzed reaction, cyanocylohexene only is formed, but in the presence of a chroma-alumina catalyst, vinyl-pyridine and cyanocyclohexene are obtained. (JACS-9)

**8.7.2.** A composition of matter comprising 30 to 60 parts of a resin prepared by condensing formaldehyde with an aliphatically substituted phenol having as its only substituent a $C_{10}$ to $C_{21}$ hydrocarbon side chain selected from the group consisting of alkyl radicals, mono-olefinic radicals and diolefinic radicals; in combination with 70 to 40 parts of a solid rubbery copolymer of 20 to 35 percent of acrylonitrile and 80 to 65 percent of butadiene-1, 3, the resin having been incorporated in the copolymer while the resin was in a fusible state. (USP-49)

## CHAPTER 9

# NITROGEN---CONTAINING RESINS

### General

**9.1.1.** Heiss, et al, studied the reactions of a 100% excess of diisocyanates with various glycols and polyols, and subsequent curing with water, to show the usefulness of the resulting polymers.

Very promising polyurethan-ureas were prepared from 2, 4-tolulene diisocyanate or 4,4¹diphenylmethane diisocyanate and a large number of polyols. The adhesion to metals, glass, and several plastics was good. Film properties could be varied over a wide range, depending on the type of polyol used. The polymers could also be used to prepare foamed resins.

Preliminary work indicates that diisocyanate-glycol reaction products, like the diisocyanate-modified polyesters, may be valuable in adhesives, coatings, films, and foams. (IEC-64)

**9.1.2.** Wolff, et al, describe the preparation of partially substituted starch carbamates both in anhydrous pyridine and in aqueous medium. Gelatinization-resistant starches result when as little as one hexamethylenecarbamly cross-link for each 500 anhydroglucose units is introduced. (JACS-33)

**9.1.3.** A process for the preparation of a hydrocarbon solvent soluble resinous material comprising heat-reacting tall oil with an aldehyde-reactable resin forming polyamino compound, adding an aldehyde and heat-reacting the mixture to form a resinous material. (USP-3)

**9.1.4.** A composition of matter comprising a compatible mixture of 5-40% by weight of a thermosetting alcohol-modified aminoplast resin and 95-60% by weight of a thermoplastic copolymer of (1) an hydroxy alkyl ester of an alpha beta ethylenically unsaturated carboxylic acid and (2) a compound containing a $CH_2=C<$ group, wherein the ratio of (1):(2) on a mol percent basis is 5:95-50:50, respectively, wherein the hydroxy group of (1) is a part of a $-CH_2OH$ group and compound (2) is devoid of any hydroxy group wherein said aminoplast resin is the condensation product of an aldehyde and a compound selected from the group consisting of urea, melamine, dicyandiamide, formoquanamine, benzoguanamine, ammeline, 2-chloro-4, 6-diamino-1, 3,5-triazine, 2-phenyl-p-oxy-4, 6-diamino-1, 3,5-triazine,6-methyl-2,4-diamino-1,3, 5-triazine,2,4,6-trihydrazine-1,3,5-triazine, 2,4,6-triethyl-triamino-1,3,5-triazine, and 2,4,6-triphenyl triamino-1,3,5-triazine. (USP-139)

**9.1.5.** A cross-linked polymer which is the product obtained by reacting, at a temperature of 25 to 200°C., a polymeric polyprimary amine having a molecular weight of at least 1000 and a main carbon chain with at least three extracatenic primary amino nitrogen groups thereon, with at least 0.5 mole, per primary amino group in said polymeric polyprimary amine, of a member selected from the class consisting of diaryl carbonates and diaryl thiocarbonates. (USP-145)

cf: 3.1.2
18.1.2

### Melamine-Formaldehyde

**9.2.1.** Wohnsiedler discusses polymerization in melamine-formaldehyde resins. This reaction belongs to the type producing polymers by condensation. In prevailing theory the typical polymer derived from polyfunctional, other than bifunctional, reactants is visualized as a highly branched, chain structure or network having growth in three dimensions and having a small number of intramolecular linkages. Actually only a fraction of functional groups in, for example, a trifunctional reaction is required to form such a network. (IEC-6)

**9.2.2.** A process of producing melamine which comprises heating in a pressure resistant vessel urea and ammonium sulfate in amounts up to and including about 10 mol percent of ammonium sulfate based on the urea taken and maintaining the thus heated materials at temperatures between about 300° C. and about 400° C. and under high pressure until substantial quantities of melamine are present in the reaction mixture, and recovering from said reaction mixture melamine thus produced. (USP-25)

**9.2.3.** In a process for the production of melamine by heating urea, exposed to a chrome-nickel stainless steel surface, to elevated temperatures under superatmospheric pressures to decompose the urea with formation of melamine and in addition thereto, ammonia and carbon dioxide as gaseous pyrolysis products of the urea, the improvement which consists in introducing into the reaction zone ammonia from an external source in amounts in the range between about 0.2 and about 1 mol per mol of urea introduced therein, maintaining reaction temperatures at about 300° C., and developing total pressures in the gas phase in contact with said

rea tion mixture of at least about 30( atmospheres and at most about 35( atmospheres. (USP-156)

cf: 7.1.8

Ma ufacturers:

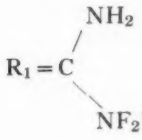
A nerican Cyanamid Company

M onsanto Chemical Company

R ohm & Haas Company

### Urea-Formaldehyde

**9.3.1.** A process for the production of a water soluble urea-aldehyde resinous product which comprises heating at least one compound of the general formula



in which $R_1$ is selected from the group consisting of oxygen, sulfur and nitrogen, and $R_2$ and $R_3$ are selected from the group consisting of hydrogen, alkyl, alkenyl, aryl, acyl radicals of saturated acids and acyl radicals of unsaturated acids in the presence of water and an ammonia compound selected from the group consisting of ammonia and alkyl, oxalkyl and hydroxyl substituted ammonia in a proportion of 1 mole of the component of the above general formula to 0.01 to 0.5 mole of the ammonia compound, thereafter adding at least one aldehyde to the reaction product and condensing the reaction product with such aldehyde, only at a pH below 7. (USP-29)

**9.3.2.** A method of producing a thermosetting resin capable of imparting superior wet strength to paper that comprises bringing together a ureaformaldehyde reaction product of less than the desired viscosity, wherein the molar ratio of urea to formaldehyde is from 1:1.9 to 1:3.0, and from 0.01 to 0.2 mol per mol of urea of a water-soluble salt of an ethylenepolyamine having not more than four ethylene groups in aqueous solution at a pH above 4, and then carrying out condensation by maintaining the solution at a pH above 4 and below 6 and heating at a temperature from 70 degrees C. to the boiling point to effect viscosity increase. (USP-149)

**9.3.3.** The Borden Company (Chemical Division) has issued Bulletin PS-105a on Casco-Resin PR-165; Wet Strength Resin for Paper.

**9.3.4.** Reichhold Chemicals, Inc. has issued Technical Bulletins SC-3 and SC-4 describing properties and uses of No. 3530 Beckamine and No. 3535 Beckamine, two new aromatic solvent soluble, urea-formaldehyde resins.

Manufacturers:

American Cyanamid Company

Bakelite Company

The Borden Company

Jones-Dabney Company

Monsanto Chemical Company

Reichhold Chemicals, Inc.

Rohm & Haas Company

Synvar Corporation

### Protein Resins

**9.4.** (No abstracts)

Manufacturers:

The Borden Company
Corn Products Sales Company
General Mills, Inc.
Hercules Powder Company

### Polyurethanes

**9.5.1.** The short history of isocyanates in the U. S. chemical industry is tied most closely to two names: DuPont and Monsanto. Both are in the spotlight: Dupont, for its new Adiprene B urethane rubber, now undergoing field tests; Monsanto, for a string of new isocyanate and diisocyanate process patents. (CW-20)

**9.5.2.** Bjorksten, et al, review the polyurethane resins with the emphasis being directed to developments subsequent to 1947. 154 references are cited. (MP-23)

**9.5.3.** Dyer & Bartels, have prepared, new polyurethans by the reaction of methylenebis-(4-phenyl isocyanate) and hexamethyl-diisocyanate with various branched 1,3-diols and with two dihydric phenols. The polyurethans made from aliphatic diols were unaffected by 1% NaOH at 50°, whereas the polyurethans from phenols were attacked. Quantitative determinations were made of the hydrolysis products, which included carbon dioxide, the diamine, the phenol and a polyurea. The polyurea was shown to result from the action of the diamine on unchanged polyurethan. (JACS-30)

cf: 9.1.1
37.6.7
39.12.3

Manufacturers:
Monsanto Chemical Company

## CHAPTER 10

# NATURAL RESINS

### General

**10.1.1.** Wood pulpers have more lignin than they know what to do with. They dump or burn most of it but there's plenty of reason to believe this by-product deserves a better fate. (CE-24)

cf: 50.2.2

Manufacturers:

Archer-Daniels-Midland Company
Delou, Inc.
France, Campbell & Darling, Inc.
D. G. Innes Corp.
Morningstar, Nicol, Inc.
U. S. Industrial Chemicals,cIn.

### Dammar

**10.2.** (No abstracts)

cf: 50.2.2

### Shellac

**10.3.1.** The Acme Shellac Products Company has issued a copy of a report by Foster D. Snell, Inc. on the Comparative Evaluation of Three Lacquer Mixing Shellacs.

**10.3.2.** Gillespie-Rogers-Pyatt Company, Inc., has issued 5-page bulletin describing properties and uses of G-R-P White French Varnishes composed of pure shellac.

Manufacturers:

Acme Shellac Products Company
Delou, Inc.
Gillespie-Rogers-Pyatt Company, Inc.

### Guar Seed

**10.4.** (No abstracts)

Manufacturers:

The Burtonite Company
Stein, Hall & Co., Inc.

## CHAPTER 11

# POLYAMIDES

### General

**11.1.1.** Feuer & Pier studied the acid-catalyzed reaction of formaldehyde with dinitriles to produce polyamides and specifically, the effect of centers of decreasing basicity in the nitrile. It was found that dinitriles containing basic centers failed to polymerize with formaldehyde. (JACS-22)

**11.1.2.** Peerman, et al, discuss polyamide resin coatings. Polyamide resins are versatile condensation polymers similar to nylon. They have inherently high impact resistance, flexibility, adhesion and gloss. They have excellent resistance to both water and grease. "Polyamide Resin 100" is a reactive polymer used to cross-link epoxy-type resins. Combinations of "Polyamide Resin 100" and epoxy resins are thermosetting and have the attractive properties of good flexibility, strong adhesion and high impact resistance. (OF-21)

**11.1.3.** Gustavson has investigated the irreversible fixation of vegetable tannins by collagen and esterified collagen, as well as by a hydrated polyamide. The polyamide possesses a marked affinity for the vegetable tannins and binds them irreversibly. (JPS-32)

**11.1.4.** A process for producing synthetic linear polyamides which comprises reacting an organic dinitrile of the formula: $NC—R'_m—CN$ wherein R' is a divalent radical from the group consisting of hydrocarbon and unreactive heterocyclic radicals and *m* is a numeral from 0 to 1 and an N,N'-dimethylolamide of the formula

$$HO—CH_2—NH—CO—R—CO—NH—CH_2—OH$$

wherein R is a divalent radical from the group consisting of hydrocarbon, unsubstituted heterocyclic, and halogen-substituted hydrocarbon and heterocyclic radicals, in the presence of a strong acid catalyst as the reaction medium, the concentration of the organic dinitrile and N, N'-dimethylolamide together constituting from 2 to 40% by weight of the reaction mixture, and continuing the reaction until a polymer of the desired intrinsic viscosity is obtained. (USP-61)

**11.1.5.** A composition of matter suitable for use in the formulation of clear and pigmented coating compositions comprising a mixture of (*a*) polymeric amide solution consisting essentially of a mixture of (1) a solution of a polymeric amide of an alkylene diamine of from 2 to 6 carbon atoms and a polybasic saturated aliphatic acid of from 2 to 8 carbon atoms in an aqueous solution of a water soluble aliphatic alcohol and containing from 10% to 20% solids and (2) a stabilizer solution amounting to from 5% to 30% by weight of the polymeric amide solution, said stabilizer being a normally liquid halogenated saturated aliphatic hydrocarbon of from 1 to 7 carbon atoms and containing a plurality of halogen atoms; and (*b*) a 40% —60% aqueous solution of a partially cured, acid curing phenol aldehyde resin, said components (*a*) and (*b*) being in intermixture in a weight ratio of from 40:60 to 60:40, respectively, calculated as the solutions. (USP-70)

**11.1.6.** A cross-linked polyamide which is the product obtained by reacting a diester of oxalic acid with a polymeric polyprimary amine having a molecular weight in excess of 1000 and having a main chain consisting solely of carbon atoms with at least three extracatenic primary amino nitrogens each directly attached by a single bond to the main carbon chain, said polymeric polyprimary amine being the product obtained by the reductive amination with ammonia and hydrogen of a copolymer of ethylene and carbon monoxide. (USP-144)

**11.1.7.** General Mills, Inc. has issued a 4-page Technical Bulletin 11-1-2, describing properties and uses of polyamide resins 90, 93, 94, 95, 100, and 115.

cf: 2.1.1
Manufacturers:
E. I. duPont de Nemours & Co., Inc.
General Mills, Inc.
Nopco Chemical Company

CHAPTER 12

# POLYETHYLENE AND MODIFIED POLYETHYLENE

### General

**12.1.1.** Lawton, et al, describe the properties of irradiated polyethylene. Polyethylene is cross-linked when irradiated with high energy electrons. The physical properties of irradiated polyethylene were measured to determine the magnitude of the changes brought about by this irradiation. Irradiation produces a cross-linked product having improved physical properties and high temperature characteristics over those of the original material. (IEC-78)

**12.1.2.** Bowers, et al, investigated the static and kinetic frictional properties of a group of unplasticized linear high polymers and copolymers, using a Bowden-Leben "stick-slip" machine. The polymers were derivatives of polyethylene containing various proportions of fluorine or chlorine.

The substitution of chlorine for hydrogen in polyethylene caused an increase in friction, and that the substitution of fluorine caused a decrease. The affect of chlorine was found to predominate when both chlorine and fluorine were substituted. (MP-14)

**12.1.3.** Higgons describes the use of a thermally sensitive blowing agent to produce cellular polyethylene by extrusion. (MP-16)

**12.1.4.** Wall, et al, studied depolymerization rates and molecular weight changes of polymethylene and mass spectrometric analyses of the volatile products obtained. The results are compared with those for commercial and radiation cross-linked polyethylene. Cross linking has little effect on the rate of depolymerization. (JACS-63)

**12.1.5.** Campbell discusses the irradiation of polyethylene. The properties are briefly discussed. (MM-11)

**12.1.6.** Baccaredda & Schiavinato measured refractive indices of polythenes by the immersion method in suitable liquid mixtures. Refractive index measurement may be suitable for the determination of the degree of branching and of the degree of crystallinity in polythenes and other polymeric substances. (JPS-29)

**12.1.7.** A method of coating surfaces with polyethylene having a melting point of at least 105° C. and a viscosity at 190° of at least 25,000 poises, which comprises applying to the surface to be coated a powdered mixture of such polyethylene and from 20% to 200%, based on the weight of the polyethylene, of a volatile solvent material of the class consisting of hydrocarbons and chlorinated hydrocarbons having a boiling point of 150° to 300° C. and which dissolves polyethylene at temperatures above 120° C., and baking the material coated with said mixture at temperatures of 120° to 230° C. but below the atmospheric boiling point of the solvent material until substantially all of the solvent is removed. (USP-72)

**12.1.8.** The General Electric Company has issued a 4-page data sheet describing the properties and uses of GE Irrathene 101, irradiated polyethylene.

cf: 50.1.14

### Polyethylene

**12.2.1.** A new explanation of polyethylene's physical and mechanical behavior has been pieced together by a team of DuPont research chemists. The key seems to be short-chain branching. It starts when the terminal carbon atom of a growing polymer chain snakes back to grab a hydrogen atom already held by another carbon in the chain. For an instant both carbon atoms share the hydrogen, forming a ring that quickly breaks when the terminal carbon takes complete possession of the hydrogen. A new long chain grows when other ethylene molecules hook on at the site vacated by the hydrogen leaving a short branch made up of the three or four carbons that were in the ring. (*CW-12*)

**12.2.2.** Tordella & Jolly describe the measurement of the melt index of polyethylene with a simple extrusion plastometer. The measurement has proved reliable, rapid, and convenient. Only minor instrument maintenance has been required over a period of more than three years. The combination of high precision plus the economy and ease of operation have made this method of measuring melt flow most satisfactory. (MP-4)

**12.2.3.** Roedel studied chain branching in polyethylene during polymerization. Two types of branching can occur during the free radical polymerization of ethylene. These two types depend upon different polymerization variables and effect different physical properties of the formed polymer. Long chain branching is due to intermolecular hydrogen transfer, is dependent upon polymer concentration, and mainly affects rheological properties. Short chain branching is believed to be due to intramolecular hydrogen transfer via transient ring formation, is dependent upon polymerization temperature, and mainly affects properties in the crystalline state. (JACS-15)

**12.2.4.** Bryant and Voter determined short chain branching in polyethylene by infrared studies. The following conclusions were reached: (1) No appreciable number of pendant methyl side chains are present. The methyl and ethyl groups are parts of longer chains most of which are believed to contain four carbons. (2) Methyl groups in unfractionated polyethylenes studied range from 0.2 to 4.6 per hundred carbon atoms. (3) Predominance of short chains over long chains tend to a larger crystallite size and a degree of crystallinity in better accord with X-ray results. The general structural picture of the polymer has been revised to conform with these findings. (JACS-16)

**12.2.5.** A new method for the quantitative estimation of chain branching is developed by Billmeyer and applied to polyethylenes. The light scattering molecular weight and intrinsic viscosity of a branched polymer are compared with those calculated for a linear but otherwise identical sample. The method is sensitive only to long branches. Some polyethylenes have from 4 to 34 such branches per molecule, on a weight-average basis. Their molecular weight distributions are extremely broad; weight-to-number average molecular weight ratios as high as 20:1 are often found. Experiments with fractionated polyethylenes confirm these conclusions. (JACS--17)

**12.2.6.** Beasley calculates the number and distribution of long chain branches, together with detailed molecular weight distribution functions from kinetic equations describing the process of radical transfer to polymer. The presence of branching causes the molecular weight distribution to be broadened with the appearance of a long high molecular "tail" on the distribution curve. (JACS-18)

**12.2.7.** Sperati, et al, show that various properties of polyethylene resins are controlled by combinations of the independent structural parameters of short chain branching, long chain branching and molecular weight. Stiffness, yield point, melting point and sorption of reagents are controlled primarily by crystallinity as affected by short chain branching and measured by density. Ultimate elongation, Vicat temperature and hardness are controlled by both density and melt viscosity (measuring molecular weight). Finally, the viscoelastic properties of the molten polymer and the ultimate strength of the solid are controlled by molecular weight and the amount long chain branching. Equations representing the relationship between these variables are presented, and an explanation is given for apparent anomalies in the literature. (JACS-19)

**12.2.8.** Wiese describes a new process for the flame-spraying of polyethylene to porous or non-porous surfaces and which does not degrade the plastic. For porous surfaces, the system includes application of a resin sizing, a coating of a resin cement, an intermediate layer of a mixture of silicon dioxide and polyethylene, and an outer layer of flame-sprayed pure polyethylene; for non-porous surfaces, the sizing operation is omitted. (MP-13)

**12.2.9.** Twenty million pounds of A-C Polyethylene—that's the estimated annual production of the new Niagara River Petrochemical Plant (Tonawanda, N. Y.) of Allied's Semet-Sovay Petrochemical Division.

This is the first plant for commercial production of ethylene from any petroleum or natural gas fraction heavier than air. The adjoining polymer plant processes the ethylene into polyethylene.

Uses include—paper processessors can, because of narrow melting range and viscosity characteristics, incorporate the polymer into petroleum waxes at lower formulation costs.

Rubber, paint, textiles, printing inks, electrical insulations—manufacturers who need non-tacky, nontoxic polymers with high chemical and abrasive resistant qualities. (CE-12)

**12.2.10.** The Semet-Solvay Petrochemical Division has issued a 2-page bulletin describing properties and uses of emulsifiable A-C polyethylenes.

**12.2.11.** The Semet-Solvay Petrochemical Division has issued bulletins SSP-I-101, SSP-I-103, #2, #3, and #4 describing the properties, uses, and compatibility of AC Polyethylenes.

cf: 2.1.1
2.1.22
18.1.2
29.2.8

Manufacturers:
Bakelite Company
E. I. duPont de Nemours & Co., Inc.
Semet-Solvay Petrochemical Division

### Halogenated Polyethylene

**12.3.1.** Amborski & Flierl discuss polyethylene terephthalate films. This polymer possesses a high melting point and good resistance to hydrolytic degradation. Mechanical, thermal, electrical and optical properties as well as permeability and chemical resistance are discussed. (IEC-4)

**12.3.2.** Smook, et al, studied infrared spectra to follow the reactions of chlorosulfonated polyethylene with amines, alcohols, and inorganic bases. The sensitivity of the molecule to water during these reactions was demonstrated, and the effect of heat on the stability of the sulfonyl chloride group was shown.

A clear picture of the mechanism of some of the cross-linking reactions of chlorosulfonated polyethylene can be obtained from this work. (IEC-27)

**12.3.3.** Polyethylene can be improved by bombarding with high energy electrons from modified X-ray equipment. This article gives a complete description of the process being developed by the Chemical Division of the General Electric Company to treat molded and extruded polyethylene. (MP-20)

**12.3.4.** Izard describes the success story of polyethylene terephthalate. The major applications so far have been as a fiber, film, or photographic film base. Its many properties make it interesting for use in coatings. (CEN-25)

**12.3.5.** Thomas made an exploratory investigation of the kinetics of the polymerization of chlorotrifluorethylene. Experiments were conducted in bulk, in solution in several solvents, and in the presence of several comonomers. Acetyl peroxide was found to be the most affective of common initiators and was used in most of the experiments. The sealed ampoule technique was employed. (JPS-11)

**12.3.6.** Hagemeyer & Stubblebine studied the physiological activity of fluorocarbon polymers. Tests were conducted using bacteria and mice. Vapors generated upon heating these polymers are highly toxic. (MP-32)

**12.3.7.** Busse & Billmeyer discuss gelation reactions of chlorosulfonated polyethylene solutions. A gelation test has been developed permitting chemicals to be screened rapidly for activity in crosslinking polymers in solution. Chlorosulfonated polyethylene can react as follows:

1. with primary aliphatic amines at low temperature to form sulfonamide links
2. with primary aliphatic amines at higher temperatures by removal of chlorine from the chain and formation of crosslinks
3. with tertury amines, urea, $NH_4OH$, etc., by unidentified mechanism
4. with rubber vulcanization accelerators by reactions not involving the sulfonyl chloride group but activated by it
5. with sulfuric acid and potassium hydroxide. (JPS-45)

**12.3.8.** The Bakelite Company has issued 15-page booklet on Fluorothene Resins—Properties, Forms, Fabrication.

cf: 2.1.1
18.1.2
18.3.1

Manufacturers:
Bakelite Company
E. I. duPont de Nemours & Co., Inc.
The M. W. Kellogg Company

## CHAPTER 13

# PHENOLICS

### General

**13.1.1.** Harris, et al, describe the modification of intermediate phenol-formaldehyde condensation products (resols) by means of epichlorohydrin. In this modification the epoxy groups of the reagent are not consumed in the process under proper conditions, but are available for further reaction with other materials such as organic acids, amines, and phenols. The degree to which the phenolic hydroxyls are blocked may be widely varied. With complete conversion, resins having excellent color, alkali resistance, and flexibility are obtained. (MP-15)

**13.1.2.** Bender presents the hardening rates of known intermediate products in the phenolic resin field reacted with "hexa." A surprising reversal of ortho and para effects is found in one section of the data. The relative importance of the known structural variables in phenolic resins is compared to their hexa-hardening rates. (MP-17)

**13.1.3.** Freeman & Lewis present a kinetic study of the alkaline-catalyzed reactions of HCHO and the methylols of phenol. Previous attempts to analyze the kinetics of the phenol-formaldehyde reactions have been limited to determination of a cumulative overall reaction rate. By means of paper chromatography it is now possible to follow quantitatively the appearance and disappearance of each individual methylolphenol in the reaction system. Mathematical analysis of the data from separate experiments involving phenol, p-hydroxybenzyl alcohol, saligenin, 2,4-dimethylol- and 2,6-dimethylolphenol, respectively, with HCHO at 30°, has provided individual rate constants for the reaction of each phenolic compound. (JACS-46)

**13.1.4.** A process for the production of a synthetic varnish resin which consists of copolymerizing a vinyl compound selected from the group consisting of ortho, meta and para-vinyl phenol, their methyl, ethyl and propyl nuclear substituted homologues having at least one reactive hydrogen atom attached directly to the nucleus and a mixture of styrene with such phenol, with a drying oil selected from the group consisting of tung-oil, dehydrated castor oil, oiticiac oil and linseed oil in the absence of oxygen, and interrupting the copolymerisation prior to gelation and adding a volatile aromatic hydrocarbon solvent for the resin. (USP-14)

**31.1.5.** A liquid, low acid number ester of an oil-insoluble phenol formaldehyde resin substantially free from methylol groups, said resin containing an average of from about 4 to about 10 phenolic groups per molecule and being derived from the acid catalyzed condensation of from 2 to 2½ moles of formaldehyde per 4 moles of phenol and being substantially free from phenol and bisphenols, the hydroxyl groups of the resin being esterified at least about 60% by means of an unsaturated higher fatty acid having at least semi-drying characteristics, said ester being substantially free from acetyl groups. (USP-21)

**13.1.6.** A composition comprising a liquid, water-insoluble condensation product of phenol and formaldehyde, which condensation product is in amount sufficient, when hardened, to set the entire composition to a rigid, solid mass, and a minor amount of a hardening agent consisting essentially of a mixture of trichloroacetic acid and benzene sulfonyl chloride containing from 33 to 98 per cent by weight of the latter. (USP-42)

**13.1.7.** As a novel resin the condensation product of furacrolein, furfural and formaldehyde, the mol ratio of furacrolein to furfural being between about 1 to 1 and about 10 to 1, and the mol ratio of furacrolein plus furfural to formaldehyde being between about 0.5 to 1 and about 1.6 to 1. (USP-63)

**13.1.8.** A continuous process for preparing novolaks of the phenol-formaldehyde condensation product type comprising the steps of continuously introducing into a first reaction vessel a phenol selected from the group consisting of monohydroxybenzene, cresol, xylenol and resorcinol, a catalyst, and formaldehyde in an amount less than that required to completely react the phenol to phenol-formaldehyde and sufficient to maintain a stationary reaction condition in said first vessel, continuously withdrawing from the first reaction vessel a stream equal in volume to the streams of the reaction components entering the first reaction vessel, continuously introducing into a second reaction vessel the stream being withdrawn from the first reaction vessel, introducing a stream of formaldehyde into said second vessel in an amount sufficient to continue the reaction of the phenol without gelatinizing the reaction mixture, and successively repeating the steps of continuously introducing reaction mixture, adding a quantity of formaldehyde to the reaction mixture to continue the reaction without gelatinization and withdrawing an amount equal in volume to that introduced in

succeeding reaction vessels until the reaction is completed. (USP-73)

**13.1.9.** A process for the production of a resin which comprises, condensing a polymeric material with an aldehyde selected from the group consisting of formaldehyde and compounds forming formaldehyde under the reaction conditions, acetaldehyde, butyraldehyde and furfuraldehyde, said polymeric material having in its molecular structure polymer units selected from the group consisting of ortho, meta and para vinyl phenol polymer units. (USP-88)

**13.1.10.** Polyhydric phenol-epoxide compositions consisting essentially of poly-epoxides free from reactive groups other than epoxide and alcoholic hydroxyl groups and polyhydric phenol polyether alcohols having terminal phenolic and intermediate alcoholic hydroxyl groups and being free from reactive groups other than hydroxyl groups. (USP-89)

**13.1.11.** The method which comprises mixing from about 0.25 to 2.50% by weight of fluoboric acid in aqueous solution with cashew nut shell liquid and heating the mixture. (USP-94)

**13.1.12.** A composition capable of hardening rapidly in the cold to yield chemically resistant masses, comprising an inert filler, a hardening agent, a still liquid resin obtained by condensing formaldehyde and phenol in the molecular proportion ranging from about 1:1 to about 1.8:1 in an alkaline medium; a compound selected from the group consisting of diethyl sulfate, dipropyl sulfate, dibenzyl sulfate, triethyl phosphate, 1,3-dichloropropanol, epichlorhydrin, dichlorhydrin, ethylene chlorohydrin, said compound being present in an amount ranging from about 5 per cent to about 25 per cent, calculated upon the amount of the resin used; and furfurol in an amount ranging from about 10 per cent to about 90 per cent, calculated upon the amount of the resin used. (USP-103)

**13.1.13.** A water soluble phenolic resin comprising the reaction product of phenolic material containing a phenol having a distillation range between 180 and 220° C. and not containing more than about 15% of at least one phenol selected from the group consisting of ortho cresol, xylenol and mixtures thereof and an alkaline redwood bark extract powder, and aqueous formaldehyde in the presence of an alkali metal hydroxide. (USP-112)

**13.1.14.** A phenol-formaldehyde resin with 80% to 100% of the hydroxyl groups esterified by means of a mixture of unsaturated higher fatty acids containing from 8-18 carbon atoms and a benzoic acid selected from the group consisting of benzoic acid and hydrocarbon substituted benzoic acids, from 5% to 20% of the total esterified hydroxyl groups being esterified with a benzoic acid. (USP-114)

**13.1.15.** The Bakelite Company has developed a new fast-curing phenolic plastic, BMG-5000.

cf: 8.7.2
15.1.9
39.1.4
49.1.7
50.5.1

Manufacturers:
Adco Chemical Company
Alkydol Labs., Inc.
Archer-Daniels-Midland Company
Bakelite Company
Durez Plastics & Chemicals, Inc.
France, Campbell & Darling, Inc.
General Electric Company
Hercules Powder Company
Krumbhaar Chemicals Inc.
McCloskey Varnish Company
Monsanto Chemical Company
Neville Chemical Company

Specialists in "Speci
In today's highly specialized production, a custom-made resin can make a great difference in product cost and performance. That is why more and more manufacturers of semi-gloss finishes—architectural, flats, high gloss enamels, varnishes, protective coatings and other products are utilizing Schenectady's customized resins. Your requirements are our specifications at no additional cost.
Schenectady products include alkyd, phenolic, terpene, maleic, resorcinal, epon* and silicone resins in liquid, lump and powdered form. We invite your inquiries.
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SCHENECTADY

Reichhold Chemicals, Inc.
Rohm & Haas Company
Schenectady Varnish Company
Snyder Chemical Corporation
Synvar Corporation
The Thibaut & Walker Co., Inc.
U. S. Industrial Chemicals, Inc.
T. F. Washburn Company

### Phenol-Formaldehyde

**13.2.1.** Sofer, et al, studied the use of ultrasonic wave propagation to follow the reaction of phenol with formaldehyde. The strong dependence of ultrasonic propagation parameters on the extent of cure of phenolic molding resins suggests that they may be used as criteria for the extent of polymerization of phenolic and other thermosetting molding resins. The technique seems capable of providing useful indication of the rate of cure. (IEC-29)

**13.2.2.** The modification of various intermediate phenol-formaldehyde condensation products (resols) by means of 1,2 epoxides is described by Harris, et al. Epoxide addition occurs at the most highly ionized position of the molecule and catalyzed by alkalies through the production of phenolate ions. The progressive conversion of phenol groups to ether linkages reduces the thermosetting properties of the resin and, with complete conversion, produces a stable product—a polyhydric alcohol. Esterification of these alcohols with organic acids results in a variety of products ranging in properties from plasticizers to materials which harden by air-drying or heat conversion. (MP-11)

cf: 50.5.1

CHAPTER 14

# ROSIN AND ROSIN DERIVATIVES

### General

**14.1.1.** Svetlik & Hanmer describe the rosin acid extension of high Mooney rubbers. (IEC-31)

**14.1.2.** Johnson reviews products derived from pine trees. These derivatives of the pine tree have served us from ancient times but their greatest value may just be coming.

Wood rosin, of itself, finds very little use in the form of a solution in solvents, as it tends to crystallize out in concentrations exceeding 20% rosin. Rosin is modified by treatment with lime, hydrogenation, conversion to alcohol (hydroabietyl), and conversion to amine.

Another important derivative of the pine tree is tall oil which is finding increased use as a source of cheap fatty acids for production of alkyd resins. (CPVM-4)

**14.1.3.** St. Clair, et al, describe a method for the preparation of fused resinates from aldehyde-modified rosin. The fused metal resinates are clear, homogeneous, noncrystalline, and have good stability in the common varnish solvents. When modified with aldehydes, rosin derivatives of low acid numbers, such as decarboxylated rosin and rosin esters, can be reacted with the acetates of cobalt and manganese to give hydrocarbon soluble resins that may contain as many as two moles of metal per mole of rosin derivative. (IEC-85)

**14.1.4.** Laws discusses crude pine gum oleoresin, and the production and processing of it into gum rosin and turpentine. The gum naval stores industry is the oldest continuously operated industry in existence in America today. People have been predicting its end but to despite its ups and downs it continues to flourish and will continue to do so as long as we have pine trees. (APJ-10)

**14.1.5.** Austin & Drew describe epoxy modified rosin esters and their use in lacquers and varnishes. Eplex 14, Eplex 15, and Eplex 16 are discussed. These are epoxy-rosin esters manufactured by Crosby Chemicals, Inc.

Preliminary results indicate superior performance of these resins in lacquers, varnishes and vehicles. (POCR-30)

**14.1.6.** Laws discusses the production and processing of crude pine gum oleoresin into gum rosin and turpentine. (PIM-2)

**14.1.7.** Stinson & Lawrence studied the effect of heat on gum rosin. The temperature range included 155° to 200° C. Moderate heating for shorter periods of time brings about an increase in softening point, a more negative optical rotation, a slight decrease in acid number, and an increase in its tendency to crystallize; higher temperatures or prolonged heating at moderate temperatures cause an opposite trend in most of these changes. (IEC-54)

**14.1.8.** The Hercules Powder Company has issued 28-page brochure describing how Vinsol Resin as a modifier of phenolic resins lowers costs and improves properties.

**14.1.9.** The Hercules Powder Company has issued 32-page brochure describing properties and uses of Vinsol Resin for Adhesives.

cf: 39.2.8
50.2.2
Manufacturers:
American Cyanamid Company
Hercules Powder Company
Newport Industries, Inc.

### Ester Gum

**14.2.1.** Hind, et al, discuss the preparation of ester gum by esterification of rosin with glycerol. The physical properties of the product can be significantly altered by varying the proportions of rosin and glycerol and by the use of catalysts. Zinc oxide is a very efficient catalyst.

The combined use of sulfur dioxide as a bleaching agent and zinc oxide as catalyst and blowing the product with superheated steam to remove volatile oils constitute a potentially practical process improvement whereby higher melting, light-colored ester gums can be made in much shorter time. (IEC-41)

Manufacturer:
Reichhold Chemicals, Inc.

## CHAPTER 15

# SILICONES

### General

**15.1.1** Kerr & Hobbs describe methods for reacting starch and starch products with substituted silanes and the properties of these starch derivatives. Three general types of products were obtained. Soluble polymers were obtained by reacting starch with monofunctional substituted silanes and with substituted silanes containing only one highly reactive substituent such as a chloro- or a small, n-alkoxy group. These starch derivatives at higher levels of derivatization were soluble in liquid hydrocarbons such as hexane or xylene. Thermosetting resins, which lost their solvent solubility with heating and time, were formed by reacting starch with bifunctional substituted silanes in which there was considerable difference in reactivity between the substituent groups attached to silicon. Insoluble cross-linked polymers resulted when starch was reacted with substituted silanes having at least two highly reactive groups. Stability of the siloxy linkage to starch appeared to increase with the size and to vary with the configuration of the other substituent groups attached to the silicon. (IEC-18)

**15.1.2** Young & Dickerman report on dielectric constants of dimethylsilicones. The dielectric constant varies smoothly with temperature over the temperature range investigated. The temperature coefficient is negative. (IEC-37)

**15.1.3** Kather & Torkelson report on sodium methylsiliconate, a silicone useful for imparting water repellency to a variety of materials. Stable, dilute, neutral solutions can be made by adding aluminum nitrate to the siliconate. The new silicone may be applied to the surface of a material or employed in integral mix. Data are presented to demonstrate effectiveness when applied to paper, brick, cement, limestone, gypsum, and casein and alkyd resin paints. (IEC-38)

**15.1.4.** Introduction of organosilylmetallic reagent could revolutionize organosilicon synthesis. It has been found possible to cleave hexaphenyldisilane and other hexaaryldisilanes in ethylene glycol dimethylether with potassium, sodium, or lithium, so that a whole spectrum of organosilylmetallic reagents is now available. (CEN-8)

**15.1.5.** Krane discusses the various applications of the silicones. In recent years paint technologists have had occasion to use silicone additives in various places in the manufacture of paint. Silicones eliminate foam in varnish kettles, prevent flooding and silking of pigmented coatings, added to bake-on enamels give an added slickness and mar-resistance to the finished article. As vehicles they produce heat resistant finishes. The protective coatings industry has found uses for silicone resins on the basis of:

1. high temperature resistance
2. high degree of water repellency
3. resistance to weathering

(CPVM-5)

**15.1.6.** Hyde, et al, prepared sodium salts of dimethylphenyl-, methyldiphenyl-, and triphenylsilanols, in high yields by the action of NaOH on the corresponding disiloxanes in alcohol solutions. These salts are readily converted to the silanols by mild hydrolysis. (JACS-12)

**15.1.7.** Fluorinated organosilanes in which the perfluoroalkyl group is separated from the silicon atom by an ethylene group have been prepared (Pierce, et al) by reaction of the Grignard reagent of 3,3,4,4,5,5,5,—heptafluoro—1—bromopentane and silicon tetrachloride or ethyl silicate. The bromide was prepared by dehydration of 3,3,4,4,5,5,5,—heptafluoro—2—pentanol followed by the addition of hydrogen bromide to the olefin in the presence of activated carbon. A silanol, silanediol and disiloxane were prepared from the fluorinated silanes as well as silicone oils. (JACS-13)

**15.1.8.** Hurd, et al, discuss the mechanism of the polymerization of polydimethylsiloxanes with strong bases. This mechanism involves 1) entry of the catalyst molecule into the siloxane system and 2) the continued action of the catalyst molecule, or some part of it, in the reshuffling of siloxane linkages. A study of the base-catalyzed polymerization of dimethylsiloxanes at room temperature in homogeneous alcoholic systems is also discussed. The nature of the silicon-oxygen-alkali metal bond has been investigated. (JACS-25)

**15.1.9.** Hedlund discusses recent developments in silicone coating resins. These resins are grouped as follows:

1. Heat resistant straight silicone resins
2. Heat resistant silicone-alkyd resins for blending
3. Silicone-alkyds for varnishes, paints and lacquers
4. Silicone-phenolics
5. Special silicone resins
6. Masonry water repellents.

(OD-39)

**15.1.10.** Osthoff & Grubb determined thermodynamic proper-

ties of octamethylcyclotetrasilane. Tri[illegible] melting point is 17.65°. Vapor [illegible]ressure of the liquid obeys the equ[illegible]tion:

$$\log P_{mm} = 45.7216 - (4530.2/T) - 12.3508 \log_{10} T.$$

En[illegible]alpy of vaporization follows:

$$\Delta H_v = 20.7 - 0.0245\ T \text{ kcal. mole}^{-1}$$

[illegible]he polymer-solvent interaction pa[illegible]meter, $\mu$, has a mean value of [illegible].28 for this system. (JACS-28)

**15.1.11.** Sommer, et al, have found three new examples of intramolecular rearrangement of alkyl from silicon to carbon, thereby demonstrating the generality of this phenomenon for organosilicon compounds. (JACS-35)

**15.1.12.** Sommer & Tyler report that steric effects of the t-butyl group have made possible the synthesis of a new class of organosilicon compounds, dialkyldiaminosilanes. Silanediols containing a t-butyl group are extremely resistant toward condensation in comparison with ordinary dialkylsilanediols. (JACS-36)

**15.1.13.** Sommer & Pioch report that the use of $Me_3SiCH_2CH_2CO$ Me and $Me_3SiCH_2CH_2CO$ Et as starting materials in a variety of condensation reactions has permitted the synthesis of a number of new silicon-containing carbonyl compounds which include $\beta$-diketones and their copper chelates, $\beta$-ketoesters, cyclic $\alpha,\beta$-unsaturated ketones, pyrazolones, a $\delta$-diketone and a furoic ester. (JACS-40)

**15.1.14.** The malonic ester synthesis has been successfully applied (Sommer, et al) in the preparation of four mono-substituted malonates containing the following organosilicon groups: $Me_3SiCH_2$-, $C_6H_5Me_2SiCH_2$, $Me_3SiCH_2SiCH_2$- and $Me_3SiCH_2CH_2CH_2$-. Trimethylsilylmethyl derivatives of glutaric and barbituric acid, a disiloxanetetracarboxylic acid and a disilaheptanoic acid are described. (JACS-41)

**15.1.15.** Sommer, et al, describe the synthesis of certain vinylsilanes and substituted vinylsilanes. The reactions of vinyltrimethylsilane with hydrogen bromide, hydrogen iodide, bromine, chlorine, ozone and butyraldehyde have been studied. (JACS-42)

**15.1.16.** Sommer, et al, describe the synthesis of seven new compounds having the trimethylsilylmethyl group directly linked to silicon. It is concluded that in reactions involving the attack of bulky reagents, the steric effects of trimethylsilylmethyl are of a magnitude intermediate between the n-alkyl and t-butyl groups. (JACS-43)

**15.1.17.** Mills & MacKenzie have developed the following set of silicon bond parachors, using the system of organic parachors developed by Vogel and co-workers as a basis:

| | | |
|---|---|---|
| Si-C: | 11.8 | (no F,O, or Cl bonded to Si) |
| | 9.2 | (C is aryl) |
| | 12.6 | (one O or up to 3 Cl's bonded to Si) |
| | 14.2 | (2 O's bonded to Si) |
| Si-O: | 12.7 | |
| Si-Cl: | 60.3 | |
| Si-I: | 107.9 | |
| Si-H: | 25.0 | (No F,O, or Cl bonded to Si) |
| | 29.1 | (1 to 3 O's or Cl's bonded to Si) |
| C-C: | 3.0 | (SiEt or SiPr except $SiR_4$ cpd.) |
| | 2.3 | ($SiEt_4$ and $SiPr_4$) |
| | 2.6 | (SiOEt or SiOPr) |
| C-O: | 16.0 | (SiOR) |

(JACS-52)

**15.1.18.** Reilly, et al, have obtained electric moments for the completely substituted methyl-, ethyl-, and phenylbromosilanes, for the partially substituted phenylbromosilanes and for p-methoxyphenyl-tribromosilane. (JACS-58)

**15.1.19.** Bond & Brockway have applied the sector-microphotometer method to the electron diffraction study of mono-, di- and trimethylsilane. The results are summarized. (JACS-59)

**15.1.20.** Grubb describes a method for measuring the rates of silanol condensation rates. The method consists of a titration of samples of the reacting solutions with Karl Fischer reagent. The titration measures the total content of SiOH groups plus $H_2O$ in the solution. Complete condensation of a silanol solution results in a reduction of the apparent water concentration to one-half of its initial value. (JACS-60)

**15.1.21.** Cooper obtained organosilicon sulfides of the type $SiCH_2SR$ by the reaction of the corresponding chlorosubstituted silane or siloxane with sodium mercaptides. The corresponding sulfones may be prepared by oxidizing the sulfides with $H_2O_2$ in acetic acid, if siloxane bonds are not present; the sulfone derivatives of the siloxanes were obtained when monoperphthalic acid in ether is used as the oxidizing agent. The sulfones underwent silicon-carbon cleavage very readily when treated with bases, but were much more resistant than the corresponding ketones, esters, and nitriles to cleavage by acids. The siloxanes were much more susceptible to silicone-carbon cleavage than the silanes. (JACS-64)

**15.1.22.** White & Rochow have investigated the reactions of silane with ethylene, acetylene and vinylsilane in a system which circulated the gaseous reactants continuously through the reaction zone. Ethylene and silane at 450-510° produced ethylsilane, diethylsilane and smaller quantities of disilane, trisilane and a compound believed to be ethyldisilane. Acetylene and silane at 460-510° gave a small amount of vinylsilane, but the bulk of the product consisted of ethynylsilane, particularly ethynyldivinylsilane. With photochemical activation, the principle products were ethylsilane, n-butylsilane and 1,4-disilylbutane from silane and ethylene, and vinylsilane from silane and acetylene. (JACS-68)

**15.1.23.** Three new silicone resins are available. Resin 2106 offers high strength. Resin 2104 offers high temperature resistance. Resin 2105 is especially suited for electrical insulation. (MM-9)

**15.1.24.** Weyer & Hoffman describe heat-resistant silicone foams. The resins are expanded in four basic steps: melting the resin, blending the reagents, expanding the mixture, and curing the foam. (MP-26)

**15.1.25.** Stapleton discusses silicone paint resins. Silicones are a new class of polymers. Polymers used for paints are usually linear high polymers or relatively low polymers with the ability to convert to a larger polymer by application of heat or absorption of oxygen (by air-drying). The use of silicones in paints makes use of one or more of the following outstanding properties of silicones:

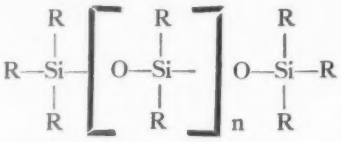
1. resistance to heat
2. color retention
3. gloss retention

4. corrosion resistance
5. weathering resistance
6. chemical resistance
(PIM-9)

**15.1.26.** A resinous composition of matter comprising a polymerizable monovalent hydrocarbon-substituted polysiloxane wherein the hydrocarbon radicals consist of both (a) vinyl radicals, and (b) monovalent radicals selected from the class consisting of alkyl and aryl radicals, all the aforementioned hydrocarbon radicals being present in the ratio of from 1.2 to 1.8 total hydrocarbon radicals per silicon atom and are directly attached to the polysiloxane silicon atoms by carbon-silicon linkages, the said vinyl radicals comprising from 1 to 20 per cent of the total number of silicon-bonded hydrocarbon radicals. (USP-8)

**15.1.27.** The process for producing solvent-soluble silicone resins from alkylsilicon halides which comprises reacting ethanol with an alkylsilicon halide containing at least two halogen atoms per silicon atom, in an amount insufficient to effect replacement of all of the halogen atoms of said silicon halide, whereby a part only of said halogen atoms are replaced by ethoxy radicals, then partially hydrolyzing the reaction product with water in the absence of a water immiscible solvent, adding a solvent for the reaction product, which solvent is immiscible with water, and then interacting the reaction product in the resulting solution with water in amount sufficient to completely hydrolyze all remaining halogen atoms and alkoxy radicals and in amount sufficient to form a separate water layer, and separating the water layer from the siloxane solution so produced. (USP-16)

**15.1.28.** The process of increasing the gloss of abrasion resistant enamels and lacquers containing polymerized ethylene which comprises preparing a gel containing 5% to 50% of polymerized ethylene based on the weight of the gel, .025% to 2.0% of a liquid alkyl polysiloxane based on the weight of the polymerized ethylene, and a solvent for the polymerized ethylene and polysiloxane, grinding said gel with pigment, non-volatile resinous organic polymeric film forming material, and volatile solvent until a uniform dispersion is obtained, and mixing the resulting dispersion with additional non-volatile resinous organic polymeric film forming material and additional solvent; said polysiloxane being represented by the structural formula in



which the various "R's" represent monovalent alkyl hydrocarbon radicals and "*n*" is a whole number greater than one; and said polymerized ethylene being solid at room temperature, having a structural formula characterized by recurrent — $CH_2$ — groups, and showing a crystalline structure by X-ray diffraction. (USP-41)

**15.1.29.** The method for the production of siloxanes which contain substituents of the group consisting of alkoxy, aryloxy and acyloxy which comprises maintaining

$$R_mH_nSiO_{\frac{4-m-n}{2}}$$

(1) a siloxane of the average general formula in which R represents hydrocarbon radicals free of aliphatic unsaturation, *m* has a value of from 1 to 2, inclusive, and *n* has a positive value up to and including 1, and (2) a reactant of the group consisting of alcohols, phenols and carboxy acids in contact with an ansolvo acid, whereby a substituent of the group consisting of alkoxy, aryloxy, and acyloxy is substituted for the hydrogen of said siloxane with the liberation of free hydrogen. (USP-59)

**15.1.30.** A liquid composition comprising a lower alkoxy silane characterized only carbon-oxygen-silicon linkages, and a small proportion of an organic base having a pKa value greater than 7 and selected from the class consisting of alicyclic and saturated aliphatic organic bases having a carbon atom content of from 2 to 12 carbon atoms per molecule and having only carbon, hydrogen, oxygen and nitrogen atoms in the molecule. (USP-62)

**15.1.31.** The method which includes the steps of partially depolymerizing a solid polydimethylsiloxane elastomer to form a viscous liquid, filtering the material while in the liquid state to remove non-silicone solids present in the elastomer, and repolymerizing the material to form a modified solid polydimethylsiloxane, said depolymerization being accomplished by subjecting the solid elastomer at approximately room temperature to an essentially anhydrous acid chosen from the class consisting of hydrochloric acid, hydrobromic acid, hydriodic acid, thionyl chloride, acetyl chloride, benzoyl chloride and phthalyl chloride. (USP-107)

**15.1.32.** A composition that produces superior coatings upon hydrolysis comprising (1) a silane whose molecule consists of a silicon atom to which are attached four monovalent radicals from one to two of which are ethyl and from two to three of which are hydrolyzable radicals; and (2) a silane whose molecule consists of a silicon atom to which are attached four monovalent radicals not more than one of which is an alkyl radical having from one to two carbon atoms; from two to three of which are hydrolyzable radicals; and one of which is a saturated cycloaliphatic hydrocarbon radical having a single nucleus containing from five to six carbon atoms each of which is connected to at least one hydrogen atom, having from five to eleven carbon atoms, and having not more than three side chains containing a total of no more than five carbon atoms, the molar ratio of (1) to (2) ranging from 2:3 to 9:1, and the ratio *r*/Si ranging from 1.1 to 1.7, wherein *r* is the total number of non-hydrolyzable radicals attached to silicon and Si is the total number of silicon atoms. (USP-128)

**15.1.33.** The Dow Corning Corporation has issued Bulletins #1-200 and #1-201 describing Dow Corning 400 Gum, a clear, high molecular weight, high viscosity, dimethyl silicone polymer. Bulletin #1-201 describes its use in compounding silicone rubber.

**15.1.34.** The Dow Corning Corporation has issued Bulletin #1-202 describing Dow Corning 410 Gum.

**15.1.35.** The Dow Corning Corporation has issued Bulletin #7-100 on silicone-based protective coatings. Performance and applications are described for straight-silicone paints, modified silicone finishes, air-drying modified silicone finishes, and silicone fluid additives.

**15.1.36.** The Dow Corning Corporation has issued Bulletin #8-300a describing properties and applications of Dow Corning Resin 129G, used for waterproofing masonry.

**15.1.37.** The Dow Corning Corporation has issued Bulletin #10-231 describing properties and applications of Dow Corning 2106 Resin, low pressure silicone laminating resin.

**15.1.38.** The General Electric Company has issued product data sheets on SR-111 silicone resin, and Dri-Film 103 silicone resin.

cf: 39.1.40
39.1.42
39.3.10
39.7.1
50.5.1
50.10.1

Manufacturers:
Dow Corning Corporation
General Electric Company
Schenectady Varnish Company

## CHAPTER 16

# STYRENES

### General

**16.1.1.** Pollock & Davis discuss five procedures for the preparation of 2, 5—Dichlorostyrene. (IEC-21)

**16.1.2.** Kut has shown that when sorbic acid is reacted with styrene by refluxing in a xylene solution, a free radical copolymerization of the monomers occurs simultaneously with the formation of a low molecular weight cyclic product. The latter has been identified as 3-methyl-1, 2, 3, 6—tetrahydrodiphenyl—6—carboxylic acid formed by Diels-Alder addition. It is suggested that the copolymerization of these two monomers proceeds through a 1,4 addition of the styrene to the conjugated (diene) system of the sorbic acid. To account for the formation of only one of the two possible Diels-Alder adducts polar attraction between the reactants, is suggested. (PVP-14)

**16.1.3.** In this third and concluding article by Kut on the reaction between styrene and unsaturated fatty acids, a study is made of the reaction between styrene and the more complex doubly conjugated $\beta$—elaeostearic acid as typical of the wood oil-styrene reaction. (PVP-22)

**16.1.4.** Swann developed two procedures for determining the polystyrene in styrenated resins. A quantitative method for determining polystyrene was needed for quality control and acceptance of quick-drying styrene-modified alkyd resins. The styrenated epoxy resins were investigated because of their related modification and their possible future interest to the Ordnance Dept. One method is applicable to either the alkyd or epoxy resins. The other, applicable to alkyds only, allows the subsequent determination of the oil acid content of the alkyd resin. Composition requirements of styrenated alkyds can be established and analytical control exercised. The extent to which monomer styrene is converted to polystyrene in the preparation of styrenated resins and oils can be determined. (AC-1)

**16.1.5.** When styrene polymerization is initiated by moderate concentrations of active monoradical-producing catalysts, the rate of initiation of polymer chains can be measured by the rate of consumption of the inhibitors. However the rate of consumption during thermal polymerization of highly purified styrene is very much greater than the rate of initiation of polymer chains. Russell and Tobolsky suggest that diradicals undergo self-termination to form small rings. While the rate of production of diradicals is very much greater than the rate of initiation of polymer chains, the actual weight fraction of the rings formed should be very small. A relation between the production of diradicals and the formation of high molecular weight polymer has not been established. (JACS-5)

**16.1.6.** Morgan measured the fluorescence bands of styrene vapor. The structure of the spectrum undergoes no change when the vapor pressure is varied from 2 to 0.06 mm., nor is any change observed in the presence of an inert gas. Polystyrene was identified as a reaction product. (JACS-6)

**16.1.7.** Shultz & Flory have obtained phase equilibria data for three ternary solvent-solvent-polystyrene systems and have interpreted these data in terms of the statistical-thermodynamic theory of polymer solution. Thermodynamic interaction parameters calculated from the observed plait points are consistent with those calculated for solvent-solvent and solvent-polymer pairs from binary system liquid-vapor and liquid-liquid phase equilibria data. (JACS-14)

**16.1.8.** Mayo studied the rate and degree of the thermal polymerization of styrene at 60, 155 and 176° in bromobenzene as solvent, with styrene concentrations from 7.6 to 0.05M. Low molecular weight, saturated, probably cyclic material and higher molecular weight, unsaturated polystyrene seem to be formed in independent reactions, and have been partially separated by precipitation of the higher polymer with methanol. Data on boiling points and unsaturation of dimer and trimer fractions are presented.

There is now no evidence for, and considerable evidence against, any participation of biradicals in the formation of high polymer from styrene. Certain aromatic solvents participate in the chain transfer with the monomer. Two mechanisms for this process are proposed which correlate observations in other polymer and non-polymer reactions. (JACS-20)

**16.1.9.** Reinforcement of styrene as is done with other thermoset plastics is now possible. Glass-reinforced polystyrene maintains its impact strength over a wide range of temperatures. It is about as strong at sub-zero temperatures as at normal room temperatures. (MP-21)

**16.1.10.** Wiley, et al, prepared and studied the polymerization of potassium p-vinylbenzenesulfonate.

It has been polymerized to high viscosities for these polymers are nonlinear functions of concentration and show a marked increase as the concentration decreases. (JACS-32)

**16.1.11.** Weisgerber & Dyer polymerized erythryl dilinoleate with styrene to give low yields of linear, soluble polymers. Limiting viscosity numbers varied from 7.6 to 12.6. The ester did not homopolymerize to high polymers. Polymers containing more than 12 mole percent of the ester were crosslinked by heat treatment. (JACS-44)

**16.1.12.** Good insulation qualities, high strength-to-weight ratio, and relatively good toughness are the properties of a new expandable polystyrene available. (MM-6)

**16.1.13.** Ziegler discusses crazing in polystyrene parts. He describes briefly the results of a recent test program designed to eliminate some of the unknowns in the crazing of polystyrene. A new crazing test is presented. (MM-7)

**16.1.14.** Horikx & Hermans applied the steady state method to the benzoyl peroxide initiated polymerization of styrene in toluene at 80°C. The theory that the time needed to reach the steady state concentrations with an accuracy of 1% or better is about seven times the average time which the mixture spends in the reaction vessel, is confirmed by experiment. The rate of polymerization can be represented by:

$-dm/dt = kmE^{1/2}; E = \beta m(1+\beta m)^{-1}$

where m is the monomer concentration; k and $\beta$ are constants. $\beta = 1.19$ liter/mole.

The apparent order of the reaction, with respect to monomer, increases from 1.18 when $m = 1.8$ mole/liter to 1.36 when $m = 0.4$ mole/liter. Numerous data from the literature concerning the polymerization of styrene and other monomers are discussed and are found to be in good agreement with the conclusions reached in the present work. Explanations are offered for a number of discrepancies found in the literature. (JPS-4)

**16.1.15.** Jellinek & Turner studied the thermal degradation of polystyrene in naphthalene solutions in high vacuum. Rates of loss of weight were determined over range 350-380°C., and the energy of activation was derived. Decrease in intrinsic viscosity with time and loss of weight as function of polymer concentrations were investigated. The mechanism of degradation in naphthalene solution is similar to that of thermal bulk degradation; an initial random chain scission (due to weak links) followed by a reverse polymerization process with chain end initiation. (JPS-5)

**16.1.16.** Hobden & Jellinek determined the rates of adsorption from solution on to charcoal and adsorption isotherms for unfractionated and fractionated polystyrene samples. Rates and extent of adsorption increase with decreasing solvent power and decreasing molecular weight. The rate curves of the fractionated samples show two distinct steps. Langmuir's adsorption equation is obeyed. Mechanisms of adsorption are discussed. (JPS-6)

**16.1.17.** Kapur determined the chain transfer constants of twelve solvents for the peroxide catalyzed polymerization of styrene and are compared, where possible, with those for methyl methacrylate. The values found are discussed in relation to structure and activity. (JPS-8)

**16.1.18.** Madorsky studied the rates and activated energies of thermal degradation of styrene and acrylate polymers. These included:

poly-meta-methylstyrene
poly-alpha-deuterostyrene
poly-alpha-methylstyrene
hydrogenated polystyrene
two methyl methacrylates
one methyl acrylate.

The styrene polymers, except hydrogenated polystyrene, degrade thermally chiefly into monomeric type molecules. In the case of hydrogenated polystyrene, breaks in the chain occur at random, the same as in polystyrene.

Polymethyl methacrylate, like the styrene polymers, breaks mostly at the radical chain ends, yielding the monomer. Polymethyl acrylate follows a mechanism of random breaking of the chains. (JPS-13)

**16.1.19.** Charlesby measured the solubility of polystyrene in benzene and toluene as a function of degree of crosslinking. Polystyrene can be crosslinked by exposure to high energy radiation. (JPS-14)

**16.1.20.** Polystyrene has been crosslinked by atomic pile radiation, the degree of crosslinking being proportional to the radiation dose. Charlesby studied the swelling properties of crosslinked polystyrene as a function of crosslinking. The energy required to produce a crosslink in polystyrene by high energy radiation is much greater than in many other linear polymers. (JPS-15)

**16.1.21.** Bawn & Wajid studied the thermodynamic properties of polystyrene solutions. Measurements were made of the osmotic pressure of polystyrene fractions in toluene and methyl ethyl ketone at 25, 50, and 55°. The heat of dilution of polystyrene in these solvents was determined. Vapor pressure measurement of polystyrene fractions in acetone, chloroform, and propyl acetate solutions are summarized and the heat of dilution in these solvents derived. The results are discussed in relation to existing theories of the free energy and entropy of dilution of polymers, and it is shown that the results cannot be explained in terms of theories based on the lattice model of solutions. (JPS-25)

**16.1.22.** Trementozzi & Buchdahl determined the molecular weight, size and second virial coefficient for a series of styrene polymers prepared under high pressure (0-4000 atmospheres) using light scattering techniques. The intrinsic viscosity—molecular weight relationship, the size-molecular weight relationship and the magnitude of the second virial coefficient reveal no significant differences when compared to similar data of regular polystyrene. Structural differences due to the method of polymerization do not exist to the extent that they can be revealed by such measurements. (JPS-28)

**16.1.23.** A fast drying, mineral spirit resistant copolymer produced by co-polymerizing a vinyl aromatic compound and a non-conjugated unsaturated oil which has been partially polymerized by blowing with a free oxygen-containing gas and which is selected from the group consisting of drying oils and semi-drying oils at a temperature of from about 225° F. to about 500° F. in the presence of from

0.02% to about 1% by weight of the oil of a heavy metal drier soluble in the oil and from 0.5% to about 2.0% by weight of the oil of a metal-free peroxide, in which copolymer the ratio of vinyl aromatic compound to oil is in the range of from 60:40 to 25:75. (USP-27)

**16.1.24.** A solid interpolymerization product of at least two different substituted alpha methyl styrene liquids consisting essentially of (1) at least one alpha-methystyrene which has at least one nuclear substituent selected from the group consisting of halogen, trifluoromethyl, methyl and hydrogen on the 3,4 or 5 positions and (2) at least one member of the group consisting of the 3,4 and 3,5 dihalo-alpha-methylstyrenes, all of the alpha-methylstyrenes being characterized by absence of substituents on the 2 and 6 positions on the nucleus. (USP-85)

**16.1.25.** The Marbon Corporation has issued 8-page revision of Technical Report CY-1, describing properties and uses of Cycolac: a new high-impact thermoplastic resin based on styrene.

cf: 2.1.1
2.1.22
4.3.2
6.2.1
17.1.3
17.1.9
18.1.2
18.1.11
18.1.12
18.1.14
20.2.1
37.2.2
44.2.9
44.2.10
50.1.4
50.4.6
50.5.3
50.10.2

Manufacturers:
Bakelite Company
Dow Chemical Company
Emerson & Cuming, Inc.
Koppers Company, Inc.
Monsanto Chemical Company
Pennsylvania Industrial Chemical Corp.

**Methyl And Dimethyl Styrenes**

**16.2.1.** A new process for methyl and dimethylstyrenes is being piloted by American Cyanamid Co.'s Stamford, Conn., laboratories. It by-passes benzene, utilizes acetylene, acetaldehyde, toluene and xylenes as starting materials. Products can replace styrene in several polymer applications, have added potential in the synthesis of new plastics. (*CW-5*)

**16.2.2.** A new method of preparing ring substituted methylstyrenes is the vapor-phase cracking of unsymetrical diarylethanes using clay catalysts at exceedingly short contact times. Dixon & Saunders describe the production of methylstyrenes and dimethylstyrenes from diarylethanes by this method. The properties of methylstyrenes and dimethylstyrenes are comparable to styrene except for their having a higher heat distortion temperature than styrene. (*IEC-49*)

cf: 16.1.18

## CHAPTER 17

# UNSATURATED POLYESTERS

### General

**17.1.1.** The use of polyester resins in the production of car bodies is discussed in terms of their use in the Corvette car body by Chevrolet. (CW-2)

**17.1.2.** Smith discusses the applications and uses of polyesters. Although unsaturated polyester resins vary in type and composition, they are generally solutions of unsaturated polyesters made from difunctional glycols and acids in a vinyl monomer. When catalyzed with a free radical catalyst, such as benzoyl peroxide, they cure by copolymerization of the vinyl monomer with the unsaturated groups in the polyester to yield a cross-linked or three-dimensional structure. The ability to cure or polymerize without evaluation of volatile byproducts is their outstanding characteristic. (IEC-67)

**17.1.3.** Parker and Moffett studied the physical properties of polyester resins. The ratio of unsaturated to saturated dibasic acid was varied in 10 mole % steps in four series of unsaturated polyesters. One of these was mixed with 20, 30, 40, and 50% styrene, while the others were mixed with 30% styrene. Flexural strength, modulus in flexure, tensile strength, modulus in tension, elongation, water absorption, and heat distortion points were determined on castings prepared from each mixture. The results are discussed. (IEC-68)

**17.1.4.** Cass and Burnett studied the inhibition of certain catalyzed polyester systems by observing viscosity changes of samples stored at room temperatures. Catalysts used were benzoyl peroxide, tert-butyl perbenzoate, ditert-butyl diperphthalate and tert-butyl hydroperoxide. Inhibitors were quinone, hydroquinone, and tert-butyl catechol. In all cases studied quinone was the most effective inhibitor. Gelation-time measurements at elevated temperatures have been used to estimate the room temperature storage life of catalyzed inhibited polyester systems. (IEC-69)

**17.1.5.** Stafford & Shay itemize typical components of unsaturated polyester formulations and fractionation methods are discussed. Attention is concentrated on the polyester; some attention given to filler and cross-linking fractions. The dicarboxylic acids are identified by the characteristic infrared spectra of their N-benzylamides. The acids are isolated as the dipotassium salts and mixtures are resolved quantitatively by the application of ultraviolet spectrophotometry. A procedure for the isolation of the dihydric alcohols is described. The applicability of the procedures is demonstrated by the analysis of a commercial formulation. (IEC-70)

**17.1.6.** Robitschek & Bean present results which indicate that the diene reaction adduct of hexachlorocyclopentadiene with maleic acid can form the major portion of polyesters with unusual flame resistance, especially in the presence of a small amount of antimony oxide. In addition, other adducts suitable as intermediates for flame resistant polyester resins are described. (IEC-71)

**17.1.7.** Bjorksten, et al, consider polyester resin-glass fiber laminates from the standpoint of bond between the two components. One silane bonding agent is treated in detail. (IEC-72)

**17.1.8.** Witt & Cizek determined the effects of particle size of a filler on the flexural strength of two different molding resins. Silica sand was chosen as the filler. The resins were a melamine formaldehyde-type and an unsaturated polyester. Data obtained from the melamine resins were in contrast with those from the polyester mixes. (IEC-73)

**17.1.9.** Bockstahler, et al, prepared a family of unsaturated polyesters with regularly varied cross-linking potential (fumarate to succinate ratio). They were copolymerized with various amounts of styrene and the copolymers tested over a range of temperatures for deflection under load and torsional modulus. The cross-linking potential of the polyester was shown to have a larger influence on the properties tested than the ratio of polyester to styrene in the copolymer. (IEC-74)

**17.1.10.** Feuer, et al, state that comparative reactivity and cured resin property data of selected polyester resins derived from maleic anhydride indicate that the reactive polyester unsaturation is actually the fumaric type. Evidence for the isomerization of maleic double bonds to the fumaric form during polyesterification is presented; only the fumaric double bond is found in two different polyesters prepared from maleic anhydride as determined by polarographic analysis. (IEC-75)

**17.1.11.** Sheppard discusses polyester-glass molding compounds. Considerable skill is required to produce a compound with good flow characteristics and molding properties. (MP-22)

**17.1.12.** Unsaturated polyester resins have a polymerization mech-

anism which utilizes maleate and/or fumarate double bonds as the sites through which the linear polyester chains are cross-linked by vinyl-type monomers. The advent of these resins has presented the problem of detecting and determining their maleate and/or fumarate unsaturation. Application of the polarograph to simple solutions of the polymer is practical if the acid number of the material, a measure of its molecular weight, is taken into consideration. A method has been developed, by Hobart, for the polarographic determination of the maleate and/or fumarate unsaturation in polyester formulations, expressed as per cent maleic anhydride. (AC-16)

**17.1.13.** A new polyester is described. Most of its service and fabrication properties are at least equal to those of conventional polyesters. At present its higher cost will limit it to uses where fire-resistance is required. (MM-4)

**17.1.14.** Yaeger discusses polyesters as coating materials. The author covers types, application methods for coating polyester resins, surface preparation, uses of polyester coatings and 18 references. (APJ-61)

**17.1.15.** A thixotropic coating composition comprising a polymerizable liquid comprising a liquid unsaturated alkyd resin obtained by the esterification of a mixture of ingredients comprising a polyhydric alcohol and an ethylenically unsaturated polycarboxylic acid and a polymerizable glycol ester of methacrylic acid and a filler selected from the class consisting of $Fe_2O_3$, $Cr_2O_3$, ZnO, $TiO_2$, $Ni_2O_3$ and $SiO_2$, the aforesaid filler comprising, by weight, from 45 to 70 percent of the total weight of the thixotropic composition. (USP-7)

**17.1.16.** A composition suitable for coating and impregnating applications comprising an aqueous solution of a heat-convertible reaction product of a polyhydric alcohol and an $\alpha,\beta$-unsaturated dicarboxylic acid, said polyhydric alcohol being selected from the class consisting of polyhydric alcohols of from 2 to 6 hydroxyl groups per molecule and mixtures thereof, said polyhydric alcohol containing no functional groups other than OH groups, containing no oxygen except in the form of OH groups and having an OH C ratio of from 0.6 to 1.0, said $\alpha,\beta$-unsaturated dicarboxylic acid being selected from the class consisting of maleic acid and maleic anhydride, said reaction product being one having at least half of the COOH groups originally presented by the reactants esterfied as evidenced by the acid value of the reaction product but at the same time having an acid value of at least the minimum value for the particular OH/COOH ratio employed as defined by line AB of the figure, said reaction product being soluble in water without the aid of any alkaline solubilizing agent said composition combining the properties of dilutability with water to at least 15% concentration of the reaction product in water and the ability to provide insoluble, infusible films by heat-conversion. (USP-10)

**17.1.17.** A surface coating composition capable of producing, on curing, a crater-free film comprising a compatible blend of (1) a polyester resin composition comprising a polymerizable mixture of (a) a polymerizably reactive unsaturated alkyd resin, (b) a compatible polymerizably reactive material having at least one $CH_2 = C<$ group and (*c*) a catalyst for accelerating the copolymerization of (*a*) and (*b*) and (2) 0.01%-5% by weight of a phenolformaldehyde resin, based on the total weight of said polyester resin, wherein the phenol is selected from the group consisting of p-tertiary butyl phenol, p-secondary butyl phenol and o-tertiary amyl phenol and wherein said alkyd resin contains a plurality of polymerizably reactive alpha, beta enal groups. (USP-33)

**17.1.18.** A method for increasing the molecular weight of a performed polyester containing, as the only reactive groups therein, at least two hydroxyl radicals which comprises mixing and reacting a major proportion by weight of said preformed polyester with a minor proportion by weight of a polylactam in which at least 2 lactam radicals are linked through their nitrogen atoms by an acyl radical of a polycarboxylic acid, each of the carbonyl groups of the acyl radical being thus attached to a lactam radical and said polylactam being free from reactive substituents. (USP-146)

**17.1.19.** The Bakelite Company has issued 19-page booklet on Bakelite Polyester Resins for Reinforced Plastics.

**17.1.20.** The American Cyanamid Company has issued 5-page bulletin on Laminac Resin 411. This resin is designed specifically for resistance to hot aqueous solutions.

**17.1.21.** The Atlas Powder Company has issued bulletins on Atlac 363—polyester binder resin for glass fibers, and on Atlac FR—flame resistant alkyd polyester resin.

**17.1.22.** The Celanese Corp. of America has issued several bulletins re: Marco Polyester Resins; a 21-page booklet giving description and formulations; a 6-page bulletin (M2) on The Marco Method for Producing Molded Laminates Between Low-Cost mating Molds; Bulletins M3 and M4 on spray coating with MR-Resin and spraying Marco ML-4 separating film.

**17.1.23.** The General Electric Company has issued a technical report describing properties and uses of their polyester resins.

**17.1.24.** The General Electric Company has issued product data sheets describing the properties and uses of G-E Polyester Resins AR 401, 403, 480, 493, 499, and 501.

**17.1.25.** The National Aniline Division has issued 52-page booklet discussing the composition and utilization of polyesters. Included are chemistry of unsaturated polyesters, uses for unsaturated polyesters, preparation of polyesters and polyester varnishes, and selected literature references.

cf: 2.1.1
2.1.12
2.1.22
37.2.2
50.3.6

Manufacturers:
American Cyanamid Company
Bakelite Company
Cargill, Inc.
Celanese Corporation of America
General Electric Company
Interchemical Corporation
Rohm & Haas Company
Shell Chemical Corporation

### Allyl

**17.2.1.** Lynn reviews the allyl resins. The term refers to polymers and copolymers formed by

either allyl alcohol or its many derivatives. The paper covers the chemistry of allyls, simple ester formation, zero-order reaction, chain transfer agents, raw materials prices and production, technology and uses, cast allyl, pro's and con's, other applications, allyl resin properties, and 54 references. (MP-3)

**17.2.2.** A number of allyl esters of carbamic acid have been synthesized by Gleim. Their properties, as well as those of some of their polymers, are reported. (JACS-23)

**17.2.3.** Lewis & Mayo studied the benzoyl peroxide-initiated reactions of propylene, isobutylene, allyl acetate and allyl chloride with carbon tetrachloride, and of propylene and isobutylene with chloroform, at 100°. Various monomer-solvent ratios and concentrations of initiator were employed. Optimum solvent-monomer feed ratios varied from 1 to 10. Nearly all reaction mixtures gave products averaging more than one monomer unit per molecule. Yields are discussed in terms of termination mechanisms, transfer constants and polar and steric effects. (JACS-29)

**17.2.4.** Butler & Johnson prepared and characterized a number of quartenary ammonium compounds having the propargyl group as one or more of the substituents to compare their polymerization characteristics to the corresponding allyl derivatives. Polymerization studies showed that only those compounds containing two or more allyl groups produced polymers, and that the propargyl groups did not enter into the polymerization. (JACS-31)

**17.2.5.** It has been shown that the diallyl esters of the arylphosphonic acids undergo polymerization to produce hard, transparent solids which are flame resistant. Further studies by Toy & Cooper, covering more than thirty allyl esters of phosphonic esters and other phosphorous-containing allyl derivatives have shown that glassy polymers are not obtained in all cases. Factors which appear to govern polymerization characteristics of these compounds are: (1) steric hindrance as determined by the size of the substituent group; (2) electrical character of the substituent group and (3) presence or absence of inhibitory groups. The dimethallyl esters polymerize faster than the corresponding diallyl esters. (JACS-48)

## CHAPTER 18

# VINYLS

### General

**18.1.1.** Lynn & Kobe describe a process for producing vinyl chloride by reaction of chlorine directly with product gases from the Schoch, Sachse, and Wulff processes which contain about 10% acetylene. Acetylene thus produced from hydrocarbons is cheaper than carbide acetylene, the vinyl chloride can be removed from the product gas more readily than acetylene, and the dilute gas prevents localized heating which destroys catalyst activity. A pure vinyl chloride that passes polymerization tests is readily made by this process. (IEC-48)

**18.1.2.** Schildknecht reviews the vinyl type polymers. The polymers obtained from ethylene, styrene, acrylic, vinyl, and vinylidene monomers make up a family unique in commercial expansion and variety of applications. (CEN-2)

**18.1.3.** For its 50th anniversary, Naugatuck is adding 50 million pounds capacity for nitrile rubber, plastics, and agricultural chemicals. Its vinyl output in being doubled. (CEN-14)

**18.1.4.** Schwahn discusses vinyl resins for industrial coatings. Fourteen years ago vinyl resins had a small but important place in the specialty field. The versatile properties of vinyl resins, have fostered a tremendous increase in production since that 'time. Correspondingly, vinyl resin prices have decreased.

Chemically the vinyl polymers would include all polymers containing the vinyl group. However it is common industrial practice to classify the polymers and copolymers of vinyl chloride and vinyl esters apart from those of styrene, ethylene and esters of acrylic acid, which chemically would be classed as vinyls.

Approximately 80% of the vinyl resin production is of the vinyl chloride type polymers. The bulk of this group are the vinyl chloride-vinyl acetate copolymers which today make up the bulk of the vinyl resins used in surface coatings. (OD-30)

**18.1.5.** Price & Morita discuss the copolymerization characteristics and spectra of phenyl vinyl sulfide and sulfone. The copolymerization characteristics of phenyl vinyl sulfide and sulfone are very nearly identical to those for methyl vinyl sulfide and sulfone. An explanation has been suggested for the lack of added conjugation when a phenyl sulfide group is attached to a vinyl or phenyl group, whereas there is a marked increase in conjugation when a vinyl sulfide group is attached to a vinyl group. (JACS-2)

**18.1.6.** Buege determined the effectiveness of a series of peroxide-type catalysts in vinyltoluene-drying oil reactions in producing clear reaction products, suitable for paint vehicles. Other factors contributing to the formation of these products are oil reactivity, ratio of oil to vinyltoluene, reaction temperature, and method of monomer addition. (IEC-77)

**18.1.7.** The use of rigid vinyl resins requires a knowledge of their thermal expansion characteristics and dimensional stability. A simple apparatus to measure differential coefficient of expansion is described by Dannis. Shrinkage during the annealing or heat-treating process is also easily measured. Expansion coefficients of a given sample depend upon method of preparation as well as upon compounding. Values are in the range of 70-200 x $10^{-6}$/°C. (MP-18)

**18.1.8.** Gilber, et al, report on vinylidene cyanide. Its homopolymerization proceeds vigorously by an ionic mechanism. Polymerization by free radical initiation is slow. The resulting polymer undergoes carbon chain scission in the presence of moisture. (JACS-37)

**18.1.9.** Westfahl & Gresham report that vinylidene cyanide reacts, in the presence of two equivalents of anhydrous aluminum chloride, with certain aromatic compounds to give monosubstituted malononitriles of the type $ArCH_2CH(CN)_2$. The reaction succeeds with aromatic hydrocarbons, phenols, phenol ethers and certain aromatic heterocycles. It fails with aromatic compounds which polymerize vinylidene cyanide or which are sufficiently deactivated by electron attracting groups. The introduction of two $-CH_2-CH(CN)_2$ groups can occur with suitably active aromatic compounds. (JACS-38)

**18.1.10.** Overberger & Kogon describe convenient synthesis of 4-vinylpyrimidine and 2-N,N-dimethylamino-4-vinylpyrimidine. Polymers have been prepared by radical catalysis and characterized. The vinylpyrimidines are inactive against Sarcoma 180. (JACS-45)

**18.1.11.** Tobolsky & Baysal review the rates of initiation in vinyl polymerization: styrene and methyl methacrylate. Following an introduction they discuss—absolute method for Determination of A (a characteristic property for each monomer), catalyzed polymerization of styrene and methyl methacrylate, computation of rates of initiation of polymer chains, combination versus disproportionation,

and catalyst efficiencies. (JPS-12)

**18.1.12.** The polymerization of certain vinyl monomers in the presence of some vinyl polymers leads to the formation of a chemical bond between the resulting two polymers. Hayes has made a study of the efficiency of this graft copolymerization process under various conditions and the following conclusions have been drawn. Increasing the catalyst concentration and temperature of polymerization increases the efficiency, while the addition of dodecyl mercaptan decreases it. The monomers used, in order of decreasing activity toward graft copolymerization are vinyl chloride, vinyl acetate, styrene. The polymers used in order of decreasing susceptibility to graft copolymerization are polyvinyl chloride, polyacrylonitrile, polyvinyl acetate and polystyrene. (JPS-16)

**18.1.13.** Frisch, et al, discuss the configuration and optical activity of vinyl polymers. Starred carbon atoms in vinyl polymers of the type $-(CH_2C^*_XY)_n-$ exist in two steric configurations (devoted here as + and −). The existence of these configurations leads to the formation of different types of polymers. No simple relation correlates the optical activity with the distribution of + and − along the polymeric chain. The various possible structures are discussed in some detail. The kinetics of such polymerizations initiated by an optically active catalyst are treated by statistical methods. (JPS-19)

**18.1.14.** Price, et al, have copolymerized β-vinylnaphthalene, 6-chloro-2-vinylnaphthalene, 4-chloro-1-vinylphenanthrene, and 2- and 3-vinylphenanthrenes with styrene, methyl methacrylate and methyl acrylate. All copolymerize well to give products generally softening at higher temperatures than polystyrene or its copolymers. (JPS-21)

**18.1.15.** Tasset & Smets studied the degradation of vinyl polymers in dilute solution (1%) in the presence of an equivalent amount of benzoyl peroxide in a temperature range from 65 to 100°C. (JPS-42)

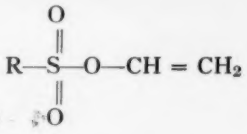
**18.1.16.** Campbell, et al, describe a method for determining the distribution of molecular weights of polyvinylpyrrolidone (P.V.P.) by measurement of the turbidity produced in aqueous solution by varying concentrations of sodium sulfate. The reproducibility and stability to autoclaving of this polymer are shown to be satisfactory. (JPS-46)

**18.1.17.** Process which comprises supplying (A) a polymerization-produced latex of a copolymer of (1) a butadiene-type compound selected from the group consisting of butadiene, isoprene, 2-methyl pentadiene-1,3, and mixtures of these compounds with (2) from about 15% to about 75%, based on the weight of the copolymer, of an acrylonitrile-type compound selected from the group consisting of acrylonitrile, methyl acrylonitrile, and mixtures of these compounds, substantially dewatering said latex without the application of heat, dissolving the copolymer in an organic solvent therefor to form a true solution thereof, incorporating in said solvent, for 20 to 120 parts of the copolymer, (B) 100 parts of a resin selected from the group consisting of polymers of vinyl chloride and copolymers thereof with up to 20%, based on the weight of such copolymers, of non-cross-linking unsaturated compounds copolymerizable therewith, casting, upon a support, a film from the resulting solution, drying said film, and stripping said film from said support. (USP-13)

**18.1.18.** A process for producing a somewhat rubbery form-stable, non-sticky, curd-like polyvinyl methyl ether which comprises polymerizing vinyl methyl ether at a temperature from about —50° C. to about—70° C. in the presence of about 1%, based on the weight of the vinyl methyl ether, of a catalyst therefor and up to 9 parts by volume of diluent per part of said catalyst. (USP-35)

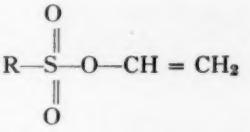
**18.1.19.** A composition of matter comprising a stable homogeneous mixture of from about 20% to 70% by weight of disodium hydrogen phosphate dodecahydrate in a bodied glyceride oil having a viscosity of from about 40 to 1100 seconds (Gardner-Holdt), the water present in said homogeneous mixture being chemically associated with the disodium hydrogen phosphate salt in the ratio of 12 mols of water to 1 mol of the disodium hydrogen phosphate salt and said homogeneous mixture being dispersed in a halogen-containing resinous polymeric material in the proportion of from .1 to 10 parts per 100 parts of resin. (USP-38)

**18.1.20.** A monomeric vinyl ester of a hydrocarbon-sulfonic acid having the formula



wherein R is a monovalent saturated hydrocarbon radical.

A method for preparing a copolymer of a vinyl ester of a hydrocarbonsulfonic acid which comprises contacting at a temperature of 0° to 150° C. with an addition polymerization initiator, a monomeric ethylenically unsaturated polymerizable compound and a monomeric vinyl ester of a hydrocarbonsulfonic acid having the formula



wherein R is a monovalent hydrocarbon radical selected from the class consisting of aryl and saturated hydrocarbon radicals. (USP-81)

**18.1.21.** Sparta Industries has announced Sparsol 77, a new vinyl type resin containing no chlorine, and which can be used as a very high solids content in solution.

**18.1.22.** The Goodyear Tire and Rubber Company introduced Pliovic DB8OV, a dry blending grade of vinyl resin.

cf: 13.1.4
13.1.9
15.1.15
15.1.26
20.1.3
20.1.4
20.3.1
49.1.7
50.10.2

Manufacturers:
Bakelite Company
Sparta Industries

### Polyvinyl Acetate

**18.2.1.** Kokes and Long have studied the diffusion at 40° of vapors of propyl chloride, allyl chloride, propylamine, isopropylamine and carbon tetrachloride into

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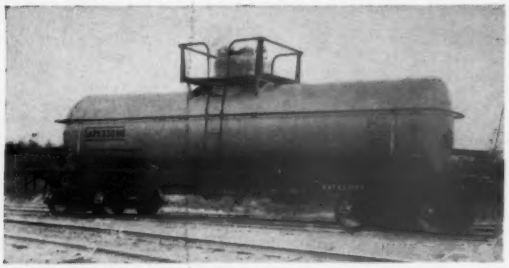

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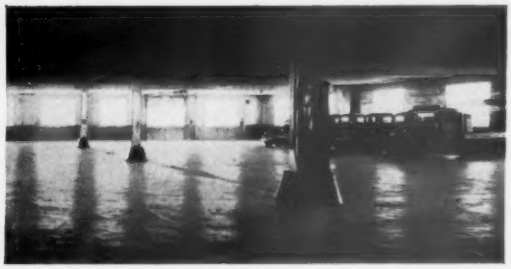

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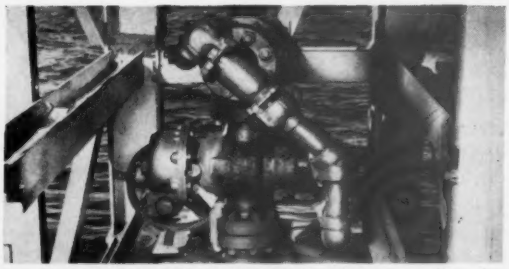

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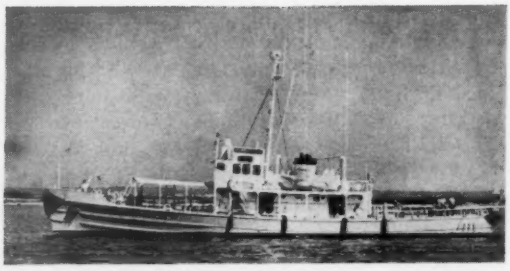

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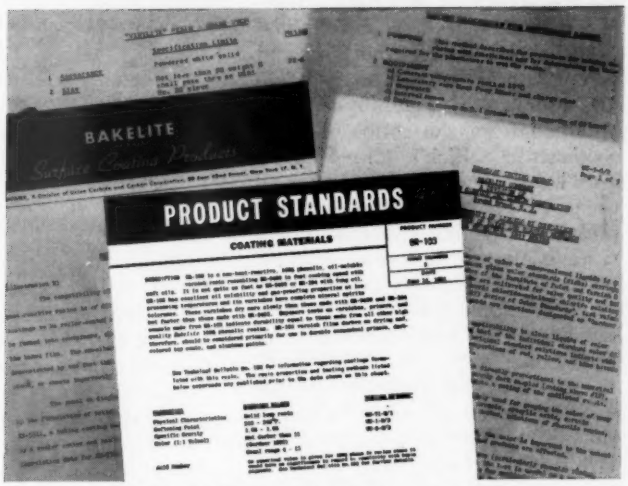


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films of polyvinyl acetate as a function of concentration. Two other vapors, 1-propanol and benzene, have been studied at three temperatures, 30, 40, and 50°. The diffusion is Fickian. (JACS-21)

**18.2.2.** Meares studied the diffusion of helium, neon, argon, oxygen and hydrogen through high molecular weight polyvinyl acetate in the temperature range 4-44°. Diffusion coefficients were determined using the time-lag method and permeabilities from steady state measurements. Solubilities were obtained from the ratios of these coefficients. Fick's and Henry's laws were accurately obeyed for all the gases over the temperature and pressure range investigated. Logarithmic plots of diffusion, permeability and solubility coefficients against reciprocal temperature show two transition temperatures. The upper one, 26°, is the same for all the gases and corresponds with the usually quoted second-order transition of polyvinyl acetate. The lower one decreases from 18-15° as the molecular size of the diffusing gas increases. The heat of solution of the gases usually reverse from (−) to (+) on entering the transition region from below. (JACS-61)

**18.2.3.** Shultz made a light scattering and viscosity study on polyvinylacetate. It confirmed the prediction that the extent to which a linear polymer molecule is expanded beyond its random-flight dimensions is a function of its molecular weight. The ratio of the mean-square radius of a linear polymer chain to its molecular weight increases with increasing molecular weight for a polymer in a thermodynamically good solvent. The Flory-Fox limiting viscosity number theory is found to be valid for high molecular weight polyvinylacetate fractions in methyl ethyl ketone. The value $\varnothing = 2.2. \times 10^{21}$ is observed for the universal viscosity constant. (JACS-62)

**18.2.4.** A liquid copolymer of vinyl acetate with a mono-olefin having from two to four carbon atoms, said copolymer containing from 60 to 80% by weight combined vinyl acetate and having an average molecular weight from 350 to 1200. (USP-51)

**18.2.5.** E. I. duPont de Nemours & Co., Inc. has issued Vinyl Products Bulletin V16-654 on "Elvadex" Vinyl Polymers; an unique vinyl acetate copolymer soluble in aqueous alkali.

**18.2.6.** The Monsanto Chemical Company has issued Product Development Bulletin describing properties and uses of Polymer C-3, a modified vinyl acetate resin.

cf: 18.1.12
Manufacturers:
American Monomer Corporation
American Polymer Corporation
Bakelite Company
The Colton Chemical Company
E. I. duPont de Nemours & Co., Inc.
Monsanto Chemical Company
National Starch Products Inc.
Paisley Products, Inc.
Shawinigan Products Corporation

### Polyvinyl Chloride

**18.3.1.** Byrne and others have found halogenated plastics such as polyvinyl chloride and polymonochlorotrifluoroethylene release halogen when exposed to gamma radiation. Thus a normally inert material becomes a source of corrosion and contamination. Tests were made on unplasticized plastics. Large changes in tensile, impact and shear strength were found—improvements in some instances and substantial deterioration in others. The results are not sufficiently complete to permit forming a hypothesis of the mechanism of the halogen evolution. It is possible, however, to estimate the order of magnitude of the evolution. (IEC-20)

**18.3.2.** General Tire & Rubber's chemical division is producing a new polyvinyl chloride resin in a new Ashtabula (Ohio) plant using a suspension polymerization process.

In general, PVC resins have the same physical properties—tensile strength, percent elongation, hardness, etc.—regardless of method of manufacture. Properties which do vary are heat stability, electrical properties, chemical resistance, and water resistance.

Of the four major types of vinyl chloride polymerization techniques —bulk, solution, emulsion, and suspension, probably no one method produces all the varieties desired. (CEN-24)

**18.3.3.** Huscher, in Materials & Methods Manual #105, covers the following, to assist in the selection and use of polyvinyl chloride: physical and chemical properties, machining and cutting, forming methods, joining methods and design suggestions. PVC is relatively new structural material now available. It offers a wide range of excellent properties such as light weight, good corrosion resistance, and ease of fabrication. (MM-3)

**18.3.4.** Arlman reports an investigation into the kinetics and the mechanism of thermal and oxidative decomposition of polyvinyl chloride. The results indicate that thermal decomposition starts at the end groups of the macromolecules, whereas oxygen initiates decomposition within the chain. (JPS-43)

**18.3.5.** A resinous composition comprising a vinyl chloride polymer plastized with an adduct of one mole of an ester selected from the class consisting of dialkyl and bis (alkoxyalkyl) esters of a dimeric, unsaturated vegetable oil fatty acid in which each alkyl and each alkoxyalkyl radical has from 1 to 8 carbon atoms and from 1 to 4 moles of a fumarate selected from the class consisting of dialkyl and bis (alkoxyalkyl) fumarates in which each alkyl radical and each alkoxyalkyl radical has from 1 to 8 carbon atoms. (USP-36)

**18.3.6.** A polyvinyl chloride resin composition containing a plasticizer, said composition having its viscosity lowered by an agent selected from the group consisting of long chain fatty acid esters of polyoxyalkylenes, long chain fatty ethers of polyoxyalkylenes, partial long chain fatty acid esters of polyoxyalkylene ethers of polyhydric alcohols, polyoxyalkylenes having an average molecular weight of at least 1500, and nuclear long chain alkylated polyoxyalkylene ethers of phenols. (USP-50)

**18.3.7.** A light-stable composition comprising a polymer of a monomeric mixture comprising from 75 to 90% by weight of vinylidene chloride, 5 to 15% vinyl chloride and 5 to 15% of ethyl acrylate and a minor amount of a water-soluble ammonium salt of a styrene maleic anhydride copolymer. (USP-104)

**18.3.8.** A process for producing polymer of vinyl chloride adapted for production of plastisols which retain mobile fluidity upon storage over extended periods of time which comprises the combination

of steps in seriatim of emulsifying liquid monomeric vinyl chloride having not more than about 5% by weight of another mono-olefinic polymerizable compound in admixture therewith and also containing a peroxide polymerization catalyst dissolved therein with an aqueous solution containing about 0.1 to 5% by weight of an emulsifying agent, homogenizing the emulsion by subjecting it to violent shearing action, heating the homogenized emulsion with agitation at a temperature of about 30° C. to 60° C. to thereby polymerize the vinyl chloride, venting unpolymerized vinyl chloride from the emulsion and thereby substantially freeing the polymer emulsion of unpolymerized vinyl chloride, and then subsequently heating the uncoagulated aqueous emulsion of polymer at a temperature of about 90° C. to 160° C. for a time from about 10 seconds to 10 minutes, but less than the time required to appreciably agglomerate and coagulate the polymer particles while maintaining the polymer in intimate contact with liquid water during the whole of this heating period. (USP-111)

**18.3.9.** The Dow Chemical Company has issued bulletin describing properties and uses of PVC 100—Dow Polyvinyl Chloride.

**18.3.10.** The Firestone Plastics Company has issued 38-page brochure describing various Exon polyvinyl chloride copolymer resins.

**18.3.11.** The Firestone Plastics Company has issued Sales Service Bulletins #8 and #11 describing Exon vinyl chloride copolymer resins 470 and 471.

**18.3.12.** The Goodyear Tire & Rubber Company, Inc. has issued 9-page Techni-Guide PVR-100-8 describing Pliovic EDB90V dry blending polyvinyl chloride resins.

**18.3.13.** The Monsanto Chemical Company has issued Opalon Data Sheet No. 061, describing Opalon 410, a vinyl chloride base resin for preparation of vinyl plastisols.

cf: 2.1.1
2.1.22
3.1.6
18.1.2
18.1.4
18.1.12
20.2.1
36.8.2
36.8.3
36.8.4
39.14.2
Manufacturers:
Bakelite Company
Dow Chemical Company
Firestone Plastics Company
B. F. Goodrich Chemical Company
The Goodyear Tire & Rubber Co., Inc.
Monsanto Chemical Company

### Chloride-Acetate Copolymers

**18.4.1.** The effects of varying catalyst concentration, temperature, and time of polymerization upon conversion, heat stability, molecular weight, and chlorine content of the copolymer of vinyl chloride and vinyl acetate were investigated by Emmer & Bankoff. In general, the results supported the theory that suspension polymerization is a special case of bulk polymerization in isolated droplets. (IEC-50)

cf: 2.1.1
4.1.7
18.1.4
20.2.4
Manufacturers:
Bakelite Company
Firestone Plastics Company

### Polyvinyl Alcohol

**18.5.1.** A process for the production of polyvinyl alcohol which comprises polymerizing vinyl acetate in the presence of a terminally unsaturated mono-olefin containing 12 to 18 carbon atoms the amount of said mono-olefin being equal to 0.01 to 10% of the weight of said vinyl acetate and the amount of any vinyl acetate solvent present during polymerization varying from zero to 30% by weight of the vinyl acetate and saponifying the resulting polyvinyl acetate until at least about 75% of the acetate groups have been converted to hydroxyl. (USP-92)

**18.5.2.** The American Monomer Corporation has issued 4-page bulletin M-13 R describing "Lemol" polyvinyl alcohol. Ten Lemol Grades are listed and properties described.

cf: 2.1.1
2.1.22
Manufacturers:
American Monomer Corporation
Bakelite Company
E. I. duPont de Nemours & Co., Inc.

### Polyvinyl Acetal

**18.6.1.** The resinous condensation product of a partially hydrolyzed polyvinyl alcohol ester homopolymer and a condensation product of ammonia and butyraldehyde. (USP-6)

**18.6.2.** A composition of matter comprising a polyvinyl acetal resin and 0.2 to 3 parts per 100 parts of said resin of a divalent heavy metal salt of fluorboric acid.

A composition of matter comprising a mixture of xylene and butanol having dissolved therein a polyvinyl butyral resin and 0.2 to 3 parts of tin fluorborate per 100 parts of said resin. (USP-142)

### Polyvinyl Butyral

**18.7.1.** Muller reviews a series of experiments on the mechanism of the action of wash primers with particular references to those based on polyvinyl butyral. The two-pack primer is superior to the single-pack type. The limited life of the wash primer is explained and other aspects of the reaction discussed, including the role of the polyvinyl butyral. The use of this material in other forms of surface coatings is also outlined. (PM-69)

**18.7.2.** Shawinigan Resins Corporation is giving one boost after another to its production of polyvinyl butyral. One of the reasons is increased use of safety glass. (CE-8)

**18.7.3.** Reacting polyvinyl acetate with butyraldehyde, Shawinigan Resins Corp., makes polyvinyl butyral resin. A Chemical Engineering Pictured Flowsheet shows how this is done. (CE-11)

**18.7.4.** The Bakelite Corporation has issued 26-page Technical Release No. 11 describing general properties and applications of Bakelite vinyl butyral resins.

cf: 2.1.1
39.2.1
39.2.4
Manufacturers:
Bakelite Company
Monsanto Chemical Company

### Polyvinyl Formal

**18.8.1.** Dieu studied the properties of polyvinyl alcohol solutions. Fractionation of an aqueous solution of crude polyvinyl alcohol was performed by acetone precipitation at 25°C. Ten fractions were obtained. Intrinsic viscosities were measured in three different solvents, water, water-dioxane (10%) and water-dioxane (33%) at several temperatures in range of 0-100°C. Flory's theory of in-

trinsic viscosity was applied to the three fractions and the values of the enthalpic and entropic parameters were deduced for the three solvents. A relation between intrinsic viscosity and the ultracentrifugation molecular weight is given. (JPS-34)

Manufacturer:
Monsanto Chemical Company

**Vinylidine Chloride Polymers**

**18.9.1.** A composition of matter consisting essentially of the copolymer of from 88 to 94 per cent vinylidene chloride and correspondingly 12 to 6 per cent vinyl chloride and from 0.5 to 5 per cent of the weight of the composition of tetrasodium pyrophosphate, from 1 to 5 per cent by weight of acetyl triethyl citrate, and from 2 to 6 per cent by weight of salol, the aggregate amounts of the citrate and salol not exceeding 9 per cent of the composition by weight. (USP-130)

cf: 2.1.1
2.1.12
2.1.22
18.1.2

Manufacturer:
Dow Chemical Company

## CHAPTER 19

# EMULSIONS

### General

**19.1.1.** Parker presents a discussion of resin polymer emulsions and their revolutionary effect on paint and a variety of other products. Discussion is primarily on use of polyvinyl acetate and includes advantages of emulsions, first use as a sealer, pigments, pH adjustment, plasticization, formulation, manufacture of polyvinyl acetate emulsions, and sampling. (CPVM-17)

**19.1.2.** An oil-in-water resin emulsion textile decorating pigment color composition comprising water, between about 4.5% and about 31% of an emulsified resin-binder, between about 0.18% and 2.16% of an emulsifying agent selected from the class consisting of soaps of fatty acids, fatty acid esters of polyethylene glycols, quaternary ammonium salts, fatty alcohol sulfates, polyethyleneoxide condensation products polymerized glycol esters and sodium salts of organic sulfonates, between about 0.075% and 4.34% of a protective colloid selected from the class consisting of casein, ammonium caseinate, methyl-cellulose, sodium carboxymethylcellulose, gum tragacanth, dextrine, starch, sodium acrylate, sodium methacrylate, water-soluble and alkali-soluble hydroxyethylcellulose, locust bean gum, water-soluble salts of the maleic adduct of styrene and alginates, between about 7% and 2[illegible]% of a dispersed pigment which is a member of the class consisting of phthalocyanine pigments, insoluble azo pigments, vat pigments and carbon blacks, said emulsified resin-binder comprising a polyunsaturated fatty acid ester of a polyhydric alcohol in an emulsion polymerized state, the vehicle solids of the emulsion being sensitive to the action of the air, when exposed to it in a thin layer of a wet film thickness of 0.0015" to 0.003", forming a coherent solid film immediately upon demulsification of the emulsion, said solid film formation being reached within a period ranging from a couple of seconds to one hour, the solid polyhydric alcohol esters forming the dispersed phase of the emulsion having an oxygen content which does not exceed the oxygen content of the unemulsified polyhydric alcohol esters by more than 2.8%, said percents being by weight and being based on the total composition, said pigment color composition being viscous and being suitable as a color concentrate which is dilutable with clear extender print paste emulsions to form the desired strength of shade when used for textile printing, said fatty acid ester being a member of the class consisting of (i) styrenated alkyd resins comprising fatty acids in the acid component, (ii) styrenated fatty oils and (iii) pentaerythritol-glycerine mixed esters of maleic anhydride treated fatty acids, all of said fatty acids containing polyunsaturated fatty acids. (USP-136)

**19.1.3.** The Union Bay State Chemical Co., Inc. is supplying a modified vinyl polymer emulsion called U 2001 Ubatol, infinitely dilutable with water, and compatible with all emulsifiable materials commonly used in floor finish compounding.

**19.1.4.** The American Polymer Company has issued brochure "Polymers for Textiles" covering Polyco emulsion polymers.

cf: 38.1.11
40.1.5
40.1.6
Manufacturer:
Snyder Chemical Corp.

### Acrylic

**19.2.1.** With a major mail order house's introduction of a line of acrylic paints in February, acrylics are making a strong bid for a share of the billion-dollar paint market. Particular baby of Rohm and Haas, the acrylic emulsions are also being produced by American Polymer Corp. (CW-11)

**19.2.2.** Fram, et al, describe reinforced acrylate elastomers cast from emulsion. Various acrylate elastomers were emulsion polymerized and compounded by direct emulsion reinforcement. Films cast from these emulsions retained their translucent optical quality as a result of a judicious choice of fillers. The strength properties were significantly improved by copolymerization with increased amounts of acrylonitrile and by loading with finely divided, non-carbon-type fillers. By the proper combination of the base elastomeric copolymer and the loading volume of the reinforcing agent, elastomers with a wide range of physical properties were developed. (IEC-88)

**19.2.3.** The Rohm and Hass Company has issued 18-page bulletin on Rhoplex AC-33; acrylic resin emulsion for water base paints.

**19.2.4.** The Rohm and Haas Company has issued 24-page Progress Report #1 on Rhoplex AC-33 for Exterior Paints.

cf: 3.1.3
40.1.5
40.1.6
Manufacturers:
American Polymer Corp.
Rohm & Haas Company

Another Quality Chemical by General Tire

# HERE'S WHAT TO LOOK FOR IN Paint Latex

You just can't buy a better paint latex than Gen-Flo*. When tested against samples of the top four competing latices Gen-Flo emerged as the best *balanced* latex—either equal to or better than other products in all the vital requirements.

For sample and reference data on Gen-Flo write to The General Tire & Rubber Company, Chemical Division, Akron, Ohio.

**COMPARATIVE LATEX PROPERTIES**

| Property | Gen-Flo Latex | Latex A | Latex B | Latex C | Latex D |
|---|---|---|---|---|---|
| Viscosity—cps. | 21 | 21 | 18 | 77 | 14 |
| Residual Styrene % | 0.03 | 0.02 | 0.22 | 0.07 | 0.05 |
| Odor | Very Mild | Very Mild | Ammonia | Sour Sweet Creamed-Thickened | Mild Custard Consistency |
| Mechanical Stability % | 0.03 | 0.02 | 0.03 | | |
| Film Specs | Good | Good | Poor | Fair | Excellent |
| Stabilization System | Balanced | Balanced | Over Stabilized | Over Stabilized | Under Stabilized |

**NON-MODIFIED PAINTS**

| Tests | | | | | | Control Paint |
|---|---|---|---|---|---|---|
| Freeze-Thaw Stability | | | | | | |
| Original—cps | 880 | 360 | 580 | 580 | 1120 | 2000 |
| After 1st cycle | 780 | 360 | 600 | 780 | coag. | 2200 |
| After 2nd cycle | 740 | 350 | 580 | 720 | — | 1850 |
| After 3rd cycle | 700 | 340 | 560 | 660 | — | 1380 |
| After 4th cycle | 850 | 370 | 620 | 900 | — | 2010 |
| After 5th cycle | 900 | 360 | 740 | 1260 | — | 2560 |
| Scrubs to Failure | | | 16 hours at −20° F. 8 hours at 77° F. | | | |
| 24 hour dry | 2000+ | 2000+ | 393 | 2000+ | 2000+ | 2000+ |
| 48 hour dry | 2000+ | 2000+ | 2000+ | 2000+ | 2000+ | 2000+ |
| Cleansability | | | Fed. Spec. TT-P-0029 with standard brush | | | |
| (strokes to remove) | | | | | | |
| Crayon | 41 | 47 | 100+ | 93 | 34 | 100+ |
| Ink | 20 | 20 | 8 | 4 | 16 | 4 |
| Lipstick | 100+ | 100+ | 31 | 34 | 100+ | 33 |
| Mercurochrome | 100+ | 100+ | 15 | 100+ | 100+ | 4 |
| Pencil | 100+ | 100+ | 100+ | 100+ | 100+ | 46 |
| | | | Fed. Spec. TT-P-0029 with standard brush, except Bon Ami instead of soap solution | | | |

**OIL MODIFIED PAINTS**

| Freeze-Thaw Stability | | | | | | |
|---|---|---|---|---|---|---|
| Original—cps | 2050 | 1490 | 1180 | 930 | 2490 | 3200 |
| After 1st cycle | 2230 | 1500 | 1700 | 1610 | coag. | 1980 |
| After 2nd cycle | 2170 | 1590 | 2280 | 3090 | — | 2070 |
| After 3rd cycle | 2100 | 1880 | 2650 | 4870 | — | 2360 |
| After 4th cycle | 2260 | 1810 | 3580 | 6680 | — | 2180 |
| After 5th cycle | 2450 | 1790 | 5310 | coag. | — | 2060 |
| Scrubs to Failure | | | | | | |
| 48 hour dry | 219 | 138 | 87 | 90 | 267 | 65 |
| 96 hour dry | 1000+ | 1000+ | 240 | 186 | 1000+ | 80 |
| Cleansability | | | Fed. Spec. TT-P-0029 with standard brush | | | |
| (strokes to remove) | | | | | | |
| Crayon | 35 | 24 | 37 | 18 | 19 | 25 |
| Ink | 10 | 7 | 31 | 5 | 18 | 17 |
| Lipstick | 54 | 46 | 73 | 36 | 33 | 15 |
| Mercurochrome | 100+ | 100+ | 80 | 47 | 100+ | 69 |
| Pencil | 59 | 83 | 85 | 25 | 27 | 58 |
| | | | Fed. Spec. TT-P-0029 with standard brush, except Bon Ami instead of soap solution | | | |

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### Polystyrene

**19.3.1.** The principle of incorporating aqueous resin or oil emulsions into "water based" paints as a means of improving the water resistance and physical properties of films produced from them is briefly reviewed by Taylor, leading to the development of the so-called synthetic resin emulsion paints based on polyvinyl acetate, polystyrene and styrene-butadiene copolymer emulsions.

"Film-forming polymer" emulsions (polyvinyl acetate and butadiene-styrene copolymers) are compared with emulsions of "non-film-forming polymers" (polystyrene, etc.), which must be plasticized by "external" means.

The manufacture and properties of polystyrene latices are discussed in general terms and the importance of correct selection of the plasticizer to ensure the production of continuous films on drying is stressed; the methods of "preplasticization" and "post-plasticization" of polystyrene latices are explained and compared.

Processes for preparing emulsion paints from post-plasticized polystyrene latices are mentioned and detailed attention is given to a discussion of the various ingredients used in this connection, their effects on the properties of the paints produced and the paint films finally obtained from them.

Plasticizers, fillers, pigments, protective colloids, preservatives, dispersing and wetting agents, defoaming agents and thickeners are dealt with in detail. (*JOCCA-27*)

cf: 19.4.2
40.1.6
44.2.21

Manufacturers:
American Polymer Corp.
Bakelite Company
Koppers Company, Inc.
Monsanto Chemical Company
Union Bay State Chemical Company Inc.

### Polyvinyl Acetate

**19.4.1.** Polyvinyl acetate seems cut out for coatings (interior, exterior, and primer-sealer) and it getting close scrutiny from paint makers. Producing fast-drying, durable, easily applied films, PVA's price is still curbing current use. But cost is on the way down, and consumption on the way up. One conservative prediction: there'll be 30 million gallons of PVA paint sold yearly by 1957. (CW-10)

**19.4.2.** A paper "Vinyl Emulsion Polymers and their Use in Coatings", presented at a meeting of the London Section of O.C.C.A. discusses subject of emulsion paints based on vinyl emulsions. The paper covers the subjects of emulsion polymerization, formation of films and emulsions, preparation of emulsion paints, testing of resin emulsion paints. The observations discussed in the paper were based on several year's work in emulsion paints during which some 1,500 samples of paint were made & tested. (PM-25)

**19.4.3.** Davis discusses polyvinyl acetate emulsions as paint vehicles. Properly formulated PVA paints have 1. excellent light stability and aging, 2. low odor, 3. fast drying, 4. excellent adhesion to fresh plaster, concrete, wood, and other surfaces, 5. excellent resistance to fat and oil, 6. good alkali resistance, 7. good washability, 8. non-bleeding, and 9. ease of application and clean up. (PVP-41)

**19.4.4.** Port, et al, describe copolymers for water base paints from vinyl acetate and long-chain vinyl esters. Some of the advantages offered by polyvinyl acetate

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emulsion paints are high gloss, strong adhesion to many surfaces, and non-yellowing characteristics. Among the problems introduced by the use of polyvinyl acetate as a binder film, on the other hand, are water-sensitivity and the need for the addition of external plasticizers. Plasticization is necessary in order to lower the temperature at which a continuous polymer film will form. (OD-42)

**19.4.5.** Zahrndt reviews polyvinyl acetate paints. Although polyvinyl acetate emulsion paints have been known in Europe and England for some years, the marked interest in their use in the United States has occurred within the past two or three years. They have caught on particularly on the West Coast. (APJ-42)

**19.4.6.** Davis discusses polyvinyl acetate emulsion as a paint vehicle. Advantages are:

1. excellent light stability and aging
2. low odor
3. fast drying
4. excellent adhesion to fresh plaster, concrete, wood, and other surfaces.
5. excellent resistance to fat and oil
6. good alkali resistance
7. good washability
8. non-blistering
9. ease of application and clean up. (APJ-46)

**19.4.7.** Davis discusses the use of polyvinyl acetate as a paint vehicle. PVA paints offer:

1. excellent light stability and ageing
2. low odor and fast drying
3. excellent adhesion to fresh plaster, concrete, wood and other surfaces
4. excellent resistance to fat and oil
5. good alkali resistance
6. good washability
7. non-blistering
8. ease of application and clean up (PIM-19)

**19.4.8.** The process which comprises dispersing vinyl acetate monomer in an aqueous 2 to 10% by weight solution of a hydrophilic dispersing agent which is a polyhydroxy, polymeric, film-forming substance substantially insoluble in water at temperatures below 50° C. but soluble in water at a temperature not lower than 50° C. to form a dispersion containing not more than 5% by weight of said monomer, subjecting said dispersion to polymerization in the presence of a peroxygen type catalyst, while dispersing therein further quantities of said monomer so as to maintain a monomer concentration not greater than 5% by weight when the polymer concentration is not over 20% by weight and not greater than 3% by weight when the polymer content has exceeded 20% by weight, continuing as above until the polymer content has reached 20 to 60% by weight, controlling the pH of the polymerization reaction mixture so that it is initially not less than 4 and finally not greater than 6 and adding to the reaction mixture before polymerization is 50% complete a cyclic alcohol selected from the group consisting of the sterols, abietyl alcohol, dehydroabietyl alcohol the hydroabietyl alcohols and the sulfonated hydroabietyl alcohols in amount equal to not less than about 0.1% by weight of the water present. (USP-69)

**19.4.9.** The American Polymer Company has issued Bulletin P-49B on American Polymer Polyco Polyvinyl Acetate Emulsions for Water Base Paints and Primer Sealers.

**19.4.10.** E. I. duPont de Nemours & Co., Inc. has issued Vinyl Products Bulletin V11-254 on Preparation of Primer-Sealers With "Elvacet" 81-900 Polyvinyl Acetate Emulsions.

**19.4.11.** E. I. duPont de Nemours & Co., Inc. has issued Vinyl Products Bulletin V15-254 on "Elvacet" 81-900 Polyvinyl Acetate Emulsion as an Exterior and Interior Paint Vehicle.

**19.4.12.** National Starch Products, Inc. and Sierra Talc and Clay Company have issued a 14-page report on a Study on The Proper Use of Extender Pigments in Polyvinyl Acetate Paints.

**19.4.13.** National Starch Products, Inc. has issued 36-page Second Edition of booklet "National Resyns for Paints" describing vinyl acetate polymer and copolymer emulsions.

**19.4.14.** The Nopco Chemical Company has issued 6-page New Product Information Bulletin NP-30 describing properties and uses of Nopco 1572-R polyvinyl acetate emulsion.

**19.4.15.** Reichhold Chemicals, Inc. has issued Technical Bulletin SC-6 describing properties and uses of 9101-55 Wallpol, a water emulsion of polyvinyl acetate.

**19.4.16.** The Shawinigan Products Corporation has issued 4-page bulletin "Gelva Emulsion for Paints". Also six technical bulletins:

Gelva Paint Thinner 175
Gelva Emulsion Primer Sealer 178
Gelva Emulsion Paint 201
Gelva Emulsion Paint 237
Gelva Emulsion Paint 243
Gelva Emulsion Paint 246

**19.4.17.** The Sierra Talc and Clay Company has issued Report 27-T on "Pigmentation Studies of Polyvinyl Acetate Paints".

**19.4.18.** The R. T. Vanderbilt Company, Inc., has issued two Technical Data Sheets describing Norvan G, a new polyvinyl acetate emulsion and the Use of Norvan G in Exterior Masonry Paints.

cf: 19.3.1
20.1.4
40.1.2
40.1.6
40.1.7
40.1.8
40.1.9
40.1.10
44.2.20
44.2.21
46.1.8
49.1.7

Manufacturers:
American Polymer Corp.
Bakelite Company
The Colton Chemical Company
Dewey & Almy Chemical Company
E. I. duPont de Nemours & Company, Inc.
National Starch Products Inc.
Nopco Chemical Company, Inc.
Reichhold Chemicals, Inc.
Shawinigan Products Corp.
R. T. Vanderbilt Company, Inc.

### Chlorinated Natural Rubber

**19.5.1.** A coating composition consisting substantially of from about 25 to 45 per cent by weight of a chlorinated rubber, having a chlorine content within the range of from about 50 to 60 per cent by weight, from about 10 to 35 per cent by weight, based on the weight of the chlorinated rubber, of a plasticizer which is miscible with the rubber chloride and exerts a gelling action thereon, a small amount of a compatible emulsifier and a vehicle of water; the rubber chloride in said com-

position being substantially free from oxygen, being substantially insoluble in organic solvents and resulting from the chlorination of an aqueous dispersion of an unmasticated rubber containing acid in a concentration of at least about 1 normal and an emulsifier stabilizing it against acid coagulation followed by recovery of the finely-divided chlorinated rubber from the resulting chlorinated dispersion. (USP-74)

**19.5.2.** Water-thinnable emulsion of chlorinated natural rubber is available as PE-16 Clear from Alfred Hague & Co., Inc. In achieving the stable emulsification of chlorinated natural rubber without oil modification heavy brush pull is overcome without sacrificing the properties of chlorinated natural rubber.

This emulsion can be used either as a modifier of other resin emulsions or as the sole film-forming portion of the vehicle in the preparation of water-thinnable paints.

**19.5.3.** Alfred Hague & Co., Inc. has issued 8-page Technical Bulletin #101 describing properties and uses of PE-16 Clear, a water-thinnable emulsion of chlorinated natural rubber.

Manufacturer:
Alfred Hague & Co., Inc.

### Butadiene-Styrene

**19.6.1.** Nisonoff, et al, describe a method based on Stokes' law, involving the use of an ordinary laboratory centrifuge, for the determination of particle size distribution in GR-S latices. It was shown to be valid by tests for reproducibility and by comparison with the results of light and electron microscopy. Data on various latices in plant production are reported. (AC-12)

**19.6.2.** The American Polymer Company has issued 5-page revision of Bulletin P-24 on Polyco Butadiene-Styrene Latices for Coatings, Adhesives, Saturants, and Paints.

**19.6.3.** The Dow Chemical Company has issued bulletin on Dow Latex 512-R, and improved latex for clay coated paper.

**19.6.4.** The Dow Chemical Company issued bulletin on Dow Latex 512-K for Exterior Masonry Paints.

**19.6.5.** The Dow Chemical Company has issued a data sheet describing the Dow Latexes (512-K, 512-R, 513-K) Styrene-Butadiene Copolymer Emulsions. Lists properties and suggested uses.

**19.6.6.** The Firestone Plastics Company has issued Sales Service Bulletin #B-1 describing the properties of Butaprene PL-1 latex, an emulsion of high styrene-butadiene copolymer.

cf: 19.3.1
36.6.1
40.1.1
40.1.6
44.2.2
44.2.4
44.2.5
49.1.7

Manufacturers:
American Polymer Corp.
Dow Chemical Company
Firestone Plastics Company
General Tire & Rubber Co.
The Goodyear Tire & Rubber Co., Inc.
Koppers Company, Inc.
Rubber Corporation of America

### Neoprene

**19.7.1.** Andersen & Arnold write on the aging stability of Neoprene latex. The most important cause of instability appears to be a slow evolution of chlorine by the polymer. Addition of dilute caustic improves the storage life. It is possible to predict the storage life of Neoprene latices. (*IEC-26*)

Manufacturer:
The American Resinous Chemicals Corp.

### Vinylidene Chloride Polymers

**19.8.** (No abstracts)
Manufacturer:
Dow Chemical Company

### Silicone

**19.9.1.** The General Electric Company has issued 5-page data sheet on SM-70, an oil-in-water emulsion of a methyl silicone fluid polymer.

Manufacturers:
Dow Chemical Corp.
General Electric Company

### Polyvinyl Chloride

**19.10.1.** The B. F. Goodrich Chemical Company has issued Service Bulletin L-4 describing properties and uses of Geon Resin and Plastic Latices; polyvinyl chloride resin emulsions.

**19.10.2.** The B. F. Goodrich Chemical Company has issued Service Bulletin L-5 describing properties and uses of Geon Latex 652, a polyvinyl chloride resin emulsion.

**19.10.3.** The B. F. Goodrich Chemical Company has issued Service Bulletin L-6 describing properties and uses of Geon Latex 450X167, a polyvinyl chloride resin emulsion.

Manufacturer:
B. F. Goodrich Chemical Company

### Petroleum Hydrocarbon

**19.11.1.** The Pennsylvania Industrial Chemical Corporation has issued 2-page bulletin describing properties and uses of Piccopale Emulsion, made from a blend of Piccopale 100 and D-165 Liquid Resin.

**19.11.2.** The Pennsylvania Industrial Chemical Corporation has issued 6-page bulletin on Piccopale Emulsion Paints.

Manufacturer:
Pennsylvania Industrial Chemical Corp.

### Natural Rubber (Latex)

**19.12.1.** The Rubber Corporation of America has issued 23-page booklet describing the properties and uses of their latex products (hevea and GR-S) and the RC plasticizers (ester-type plasticizers).

Manufacturers:
The General Tire & Rubber Company
Rubber Corporation of America

### Acrylic-Butadiene Copolymer

**19.13.** (No abstracts)

Manufacturer:
American Polymer Corp.

### Nitrogen-Containing Terpolymer

**19.14.** (No abstracts)

Manufacturer:
American Polymer Corp.

# PLASTICIZERS

## CHAPTER 20

# PLASTICIZERS

### General

**20.1.1.** Plasticizers have been usurping front center of the chemical markets stage. Price fluctuations—official and under-the-counter—have been the principal act. Plasticizer output and sales in 1953 not only were substantially better than 1952 volume, but also top the previous all-time highs chalked up in 1951. (CW-19)

**20.1.2.** As the plasticizer industry continues to broaden, it also becomes more complex. No longer can the end user of vinyls afford not to know the basic facts about the various members of the plasticizer families and what each has to offer.

Morris in the first of three articles discusses the types of plasticizers used with vinyl chloride film and sheeting. (MP-2)

**20.1.3.** Bergen, et al, in the second of three articles on plasticizers for vinyls, covers plasticizers for molding and extrusion compounds. (MP-5)

**20.1.4.** Deckel in the third article on plasticizers for vinyls covers plasticizers for vinyl dispersions. There are two basic systems used to make vinyl dispersions—vinyl resin dispersed in non-aqueous media and vinyl resin dispersed in water. The non-aqueous dispersions fall into two divisions—plastisols and organosols. The second group, water dispersions or vinyl latices, comprises several varieties, the major types being vinyl chloride polymers and copolymers, and polyvinyl acetate.

Although many of the principles of plasticizer selection are identical for both systems, there are also many differences which characterize and distinguish the two. (MP-10)

**20.1.5.** Emery Industries, Inc. has issued 34-page booklet describing properties and uses of Plastolein Plasticizers. These include azelates and polymeric types.

**20.1.6.** The Monsanto Chemical Company has issued 63-page Bulletin on "Monsanto Plasticizers—Uses, Properties, and Specifications." These include phthalates, phosphates, sulfonamides, phthalyl glycollates, adipates, chlorinated polyphenyls, and specialty plasticizers.

**20.1.7.** The Bakelite Company has issued 4-page Technical Bulletin No. 1 describing the applications and properties of Halowax Product 4004, a liquid chlorinated aliphatic hydrocarbon of medium viscosity and light color.

cf: 5.4.1

### Chemical

**20.2.1.** Greenspan & Gall describe a new series of vinyl plasticizers, epoxy fatty acid esters, distinguished by generally good overall plasticizer properties combined with unique attributes of their own. (IEC-25)

**20.2.2.** Gamrath, et al, describe the chemical and physical properties of the alkyl diaryl phosphates. They exhibit good stability and other excellent characteristics in comparison with esters in general. They are useful as plasticizers, especially for polyvinyl chloride and polyvinyl copolymers. (IEC-35)

**20.2.3.** Caldwell & Fowler devised a method for quantifying the standard potassium permanganate test applied to tricresyl phosphate. By measuring the color change of the $KMnO_4$ solution with a photoelectric photometer, subjective judgments are eliminated and more precise comparisons of materials by this test made possible. (ASTM-8)

**20.2.4.** Quackenbos, Reed, et al discuss plasticizer performance in vinyl resins. New test procedures have been developed for the loss of plasticizer into soapy water and into mineral oil, an apparatus has been devised whereby the sample is dragged through absorbent powder. This "rub-off" test of plasticizer loss simulates the treatment that must be withstood by vinyl upholstery. The study of the mechanism has shown why results for the soapy water, oil, and rub-off tests are often similar, why loss is proportional to the square root of time, under some conditions, a property of the plasticizer itself—for example, vapor pressure—governs loss from the plasticized sample. (IEC-61)

**20.2.5.** Process for the production of 1,3,5-ethylxylene, a plasticizer with a higher-than-ordinary softening point. Gives promise of improved polystyrene resins. Use of polydimethylstyrene resins has been limited by a low (212°F) softening point attributed to the presence of dehydrogenated o-ethyl xylenes in the plasticizer-usually a mixture of ortho and meta ethyl xylenes.

Process uses a Friedel-Crafts reaction to make high grade 1,3,5-ethylxylene. This could be the looked-for high melting plasticizer. Using it for resin production would minimize formation of the low melting intermediate usually encountered. This article is a report on U. S. 2,661,382—Arthur F. Lien & David A. McCauley as-

sig ed to Standard Oil Co. (Ind.) (C -14)

**0.2.6.** The Atlas Powder Compa y has issued 6-page technical bu letin describing G-2401, a noncr stallizing plasticizing polyol for m isture-conditioning.

**0.2.7.** The Atlas Powder Compa y has issued 25-page technical bu letin describing the use of Pycal Pl sticizers in Polyvinyl Acetate Emulsion adhesives.

**0.2.8.** The Atlas Powder Company has issued 6-page technical bulletin describing the properties and uses of Pycal 170—an auxiliary Low Temperature Plasticizer for Polyvinyl Chloride.

**20.2.9.** Godfrey L. Cabot Inc. has issued product data folders on Cabot Plasticizers Cabflex ODA and Cabflex ODP. The ODP is an iso-octyl decyl phthalate while the ODA is an iso-octyl decyl adipate.

**20.2.10.** The Carbide & Carbon Chemicals Company has issued 4-page bulletin F-8521 describing properties of Flexol Plasticizer 77-G: dipropylene Glycol Dibenzoate.

**20.2.11.** The Carbide & Carbon Chemicals Company has issued 5-page bulletin F-8622 describing the properties of Flexol Plasticizers 810 and 812, two new phthalate plasticizers.

**20.2.12.** Eastman Chemical Products, Inc. has issued 48-page booklet describing properties and uses of 11 Eastman Plasticizers. These include 7 phthalates, 2 adipates, triacetin and tributyrin.

**20.2.13.** The Monsanto Chemical Company has issued Technical Bulletin No. O-89 describing properties and uses of Santicizer 141, "the non-toxic plasticizer."

**20.2.14.** The Monsanto Chemical Company has issued Technical Bulletin No. 0-106 describing properties and uses of dioctyl adipate.

**20.2.15.** The Monsanto Chemical Company has issued Technical Bulletin No. 0-109 describing properties and uses of di (n-octyl, n-decyl) phthalate.

**20.2.16.** The Monsanto Chemical Company has issued Technical Bulletin No. 0-113 describing properties and uses of diisodecyl adipate.

**20.2.17.** The National Lead Company has issued 4-page bulletin on Dutch Boy Plasticizer NL A-54, a new phthalate plasticizer for vinyl resins.

**20.2.18.** The National Lead Company has issued 4-page bulletin on Dutch Boy Plasticizer NL F-21, a new general purpose vinyl plasticizer with unusually low volatility.

**20.2.19.** The National Lead Company has issued 4-page bulletin on Dutch Boy Plasticizer NL F-31, a new vinyl plasticizer with an excellent balance of properties.

**20.2.20.** The National Lead Company has issued 4-page bulletin on Dutch Boy Plasticizer NL F-41, a new low temperature vinyl plasticizer.

**20.2.21.** The Ohio-Apex Division has issued technical data sheets on Kronitex MX, Kronitex K-3, Dinopol IDO, and Adipol 810; new phosphate and adipate plasticizers.

**20.2.22.** The Pan American Chemicals Division has issued 10-page bulletin "Panaflex BN in Vinyl Chloride and Copolymer Resins". It finds extensive use as a co-plasticizer for vinyl resins.

**20.2.23.** Chas. Pfizer & Co., Inc. has issued Technical Bulletin No. 31 on "Citric Acid Esters as Plasticizers". Properties of Citric Acid Esters, plasticizer performance, experimental citric acid esters, and a bibliography are included.

**20.2.24.** The Pittsburgh Coke and Chemical Company has issued a technical bulletin on Pittsburgh PX Plasticizer PX-114, a new economical phthalate plasticizer.

**20.2.25.** The Pittsburgh Coke and Chemical Company has issued a technical bulletin on Pittsburgh PX Plasticizer PX-118, an isooctyl decyl phthalate.

**20.2.26.** The Tennessee Products and Chemical Corporation has issued a series of bulletins describing the Benzoflexes, a series of dibenzoate ester plasticizers.

**20.2.27.** The Witco Chemical Company has issued Bulletin E-6 describing properties and uses of Witco dioctyl phthalate.

**20.2.28.** The Witco Chemical Company has issued Bulletin E-7 describing properties and uses of Witco di-iso-octyl phthalate.

**20.2.29.** The Monsanto Chemical Company now makes two low-temperature plasticizers for polyvinyl chloride resins; DOA (dioctyl adipate) and DNODP (di-n-octyl n-decyl phthalate).

**20.2.30.** Pittsburgh PX-114, a new low-cost phthalate plasticizer from Pittsburgh Coke and Chemical is said to be compatible with other plasticizers. PX-114 (decyl butyl phthalate) will give vinyl plastics good low-temperature flexibility, good mechanical properties, and permanence.

cf: 19.12.1
20.1.5
20.1.6
37.2.2

Manufacturers:
Advance Solvents & Chemical Corp.
Atlas Powder Company
Baker Castor Oil Company
Barrett Division
Godfrey L. Cabot, Inc.
Carbide & Carbon Chemicals Company
Commercial Solvents Corporation
Dewey & Almy Chemical Company
Diamond Alkali Company
Eastman Chemical Products, Inc.
Emery Industries, Inc.
Hercules Powder Company
Monsanto Chemical Company
National Lead Company
Ohio-Apex Division
Pan American Chemicals Division
Chas. Pfizer & Company, Inc.
Pittsburgh Coke & Chemical Company
Rohm & Haas Company
Rubber Corporation of America
Witco Chemical Company
Wyandotte Chemicals Corp.

### Resinous

**20.3.1.** Aelony correlates the structure of aromatic sulfonamides and their performance as plasticizers and waxes. Several series of compounds were synthesized and tested for plasticizing action on vinyl resins and for waxlike properties. (IEC-46)

**20.3.2.** The Pittsburgh Coke & Chemical Company has issued a technical bulletin on Pittsburgh PX-800 Epoxy; a highly compatible polymeric-type (epoxy) plasticizer for use with vinyl resins.

cf: 3.1.6
20.1.5
20.1.6
20.2.4

Manufacturers:
Baker Castor Oil Company
Cargill, Inc.
Diamond Alkali Company
Emery Industries Inc.
General Electric Company
Hercules Powder Company
Monsanto Chemical Company
Pan American Chemicals
Pittsburgh Coke & Chemical Company
Rohm & Haas Company
Rubber Corporation of America

### Plasticizing Oils

**20.4** (No Abstracts)

Manufacturers:
Archer-Daniels-Midland Company
Baker Castor Oil Company
Pacific Vegetable Oil Corporation

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**BP-192-D.** A water dispersible pigment for resin-emulsion and latex base paints.

**BT-297-D.** A green-shade, full strength pigment that produces attractive two-tone effects when metallized.

**BW-372-P.** A standardized water paste for emulsion paints.

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| MONASTRAL® | "RAMAPO" |
|---|---|
| GT-674-D | GP-501-D |

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| MONASTRAL® | "RAMAPO" |
|---|---|
| GT-751-D | GP-755-D |

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## SHADING YELLOW

**Y-493-D.** Just this *one* Shading Yellow—blended with standard Milori Blues—is all you need to produce greens fully equal in quality to the more expensive Chrome Greens.

## CHROME YELLOWS

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|---|---|---|
| Y-433-D | Y-434-D | Y-469-D |

Lightfast, brilliant, easy to disperse. These pigments mix readily to provide a smooth, uniform mill base. Careful and complete standardization assures uniform quality.

## ZINC YELLOW

**Y-539-D.** HIGH CHROMATE TYPE—Meets the requirements of all Zinc Yellow specifications. Gives lightfast decorative finishes . . . non-staining in industrial atmospheres.

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## CHAPTER 21

# GENERAL PIGMENTS

### General

**21.1.1.** Kienle & Maresh reproduce electron, and some optical, micrographs to illustrate the influence on the optical properties of films, of the following pigment properties: refractive index, light absorption, particle shape and size, degree and method of deflocculation, weathering, gloss and surface inperfections. (JOCCA-9)

**21.1.2.** Urich reviews progress and recent developments in inorganic colors. Included are chrome yellows, molybdate orange, chrome greens, zinc yellow, & iron oxides. (PVP-5)

**21.1.3.** Permut reviews organic colors. Included are reds (toluidene, lithol etc.), maroons, yellows (hansa & green gold), orange (permanent, ortho), greens (phthalocyanine), & blues (phthalocyanine & indanthiene). Water dispersible pigments, and water dispersions are discussed. (PVP-6)

**21.1.4.** Morris reviews pigments for industrial finishes. Traditional white and black are being replaced by all of the rainbow's many hues, in both pastels and deep-tones. (PVP-12)

**21.1.5.** Morgans reports on pigment progress. In addition to the continuing interest in the established pigments, there has been an increased amount of work devoted to the preparation of treated pigments, which are more readily dispersible for use in either orthodox or other paint vehicles. In particular, the increasing demand for emulsion paints has focused attention on the advantages to be gained if a wider range of pigments easily dispersible in water were available. Similarly, very fine grinding of pigments and extenders continues to attract considerable attention, and a review of the newer types of colloid mills and disintegrators has been noted. (PM-13)

**21.1.6.** An unusual example of a modern scientific industry operating in what is still little more than a large village is the Yate Branch of Golden Valley Colours Ltd. This article briefly describes their manufacture of pigments. (PM-29)

**21.1.7.** Madson discusses pigmentation of flat paints. The following are presented:

1. pigmentation for flat paints having excellent color uniformity over surfaces of varying porosity.
2. a method of recording color uniformity data and a simplified method of studying paint problems.
3. data on the effect of blends of $TiO_2$ and titanium calcium pigmentation of flat paints.
4. a method for studying paints at constant titanium dioxide pigment content and varying P.V.C.
5. results of study on the effect of extenders on hiding power, brightness and pigment volume concentration of flats.
6. a brief review of the use of odorless vehicles and solvents in flat paints. (PVP-48)

**21.1.8.** Parker describes the pigmentation of industrial finishes. The problem of pigmentation can be divided into two broad groups, ie, durable and non-durable. Good package stability, application properties, adhesion, flow, leveling, gloss, hiding, and initial film characteristics are required in both. (OD-45)

**21.1.9.** North described colored pigments in an address to the Leeds Junior Branch of the Society of Dyers and Colourists. Apart from the resistance to various destructive agencies which arise from the chemical nature of the pigment, physical condition, crystal structure, surface properties and other physical properties all take part in determining the behaviour of the pigment. (PM-65)

**21.1.10.** Rowland reviews the progress in the application of pigment colors to textiles. Pigment colors are assuming an increasingly important role in the decoration of textile fabrics. The most recent developments (O/W printing systems, printing on synthetic fibers nylon crinkle, tipping and inlay printing, glass printing, and aniline black carriers) are the products of programs started two to five years ago. Work in the future will include continued improvement of the fastness of W/O and O/W systems to crocking, washing, dry cleaning, as well as improvements in formulation, development of new pigments and resins, formulation of pigmented colors for new fibers, and special products to meet new end-use requirements. (IR-2)

**21.1.11.** Peacock discusses types of colorants for plastics. Hue, resistance to heat, resistance to light, resistance to bleeding, resistance to chemicals and color index numbers are covered in 10 tables including red, orange, yellow, green, blue and violet, brown, black, and white pigments, and oil-soluble and water-soluble dyes. (MP-28)

**21.1.12.** The New York Club presents a study of the pigmentation of emulsion systems. The study was based on butadiene-polystyrene and on plasticized polystyrene systems at 15, 30, and 45%

P.V.C. The following types of preparation were included:

1. three-roller mill
2. high-speed mixer
3. high-speed stone mill
4. Colloid mill
5. pebble mill

Studies were made on package stability and film characteristics. (POCR-6)

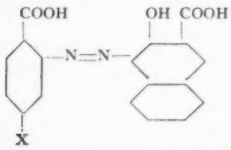
**21.1.13.** Singer presents the first part of Chapter VII in his "Fundamentals of Paint, Varnish, and Lacquer Technology" on pigments. (APJ-4)

**21.1.14.** Singer presents part II of Chapter VII of Fundamentals of Paint, Varnish, and Lacquer Technology. The chapter covers pigments, and this part discusses color pigments and metallic pigments. (APJ-8)

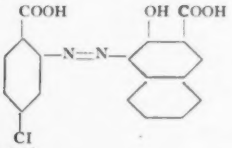
**21.1.15.** Wakefield reviews recent developments in chemical colors, including red, orange, yellow, green, blue and aqueous pigment dispersions. (POCR-26)

**21.1.16.** Eight grate and hopper magnets save $6,000 annually at color pigment plant of Kentucky Color & Chemical Company. The magnets remove particles of rust weighing fractions of an ounce, large bolts and iron scrap which ordinarily contribute to the three major causes of pigment production problems: product contamination, machinery damage, and fire-breakouts. (PIM-10)

**21.1.17.** As a new insoluble azo maroon pigment, the manganese salt of the azo dyestuff having the formula in which X is a substituent selected from the group consisting of halogen and nitro.




A durable synthetic alkyd resin coating composition containing as pigmenting ingredients a minor proportion of powdered aluminum and a major proportion of the manganese salt of the insoluble azo maroon dyestuff having the formula:




(USP-20)

**21.1.18.** A pigment comprising discrete particles in solid state of clay individually coated with a condensation product of formaldehyde and at least one material of the group consisting of (*a*) urea, (*b*) phenol and (*c*) melamine, which condensation product is capable of further advancement, prepared by spray-drying an aqueous mixture of clay and one of the group consisting of (*i*) a water solution of said condensation product and (*ii*) a water dispersion of said condensation product. (USP-109)

**21.1.19.** E. I. du Pont de Nemours & Co. (Inc.) has issued Technical Service Bulletin No. 20—Dupont Pigment Colors for Emulsion Paints.

cf: 2.2.2
5.4.1
38.1.10
38.2.8
38.3.1
39.1.2
39.1.3
40.1.4
40.1.5
46.3.1
50.1.2
50.1.3
50.3.1
50.8.1

### Color and Color Cards

**21.2.1.** Willmer notes that surface colors not only depend on physical factors, such as the composition of the incident light and the nature and texture of the surface, but also on physiological factors which modify the performance of the receptive mechanisms in the eye. Some anomalies of color perception which depend on such physiological factors can be demonstrated. (JOCCA-2)

**21.2.2.** The application of color to buildings is discussed by Hurst, with special emphasis on contempory trends. Some consideration of the three-dimensional aspect of color and color solids is given, with brief reference to the Ostwald and Munsell systems. The scientists' and artists' conceptions of color are compared. The functional use of color in buildings and the application of "selective" color in relation to the natural lighting in a room, and the avoidance of unwanted discords, are outlined and the effects of lighting on color pointed out. (JOCCA-22)

**21.2.3.** Corcoran discusses the factors which determine the color which results when two or more pigments are mixed. It is assumed throughout that there is no chemical reaction between the substances, and that the pigments are ground together sufficiently finely to prevent either color from showing separately. (PM-41)

**21.2.4.** Engel discusses the selection of colors and color designs for painting. The author discusses the language of color, color design composition, contrasting factors, psychological factors, the mechanics of color selection, procedures in color selection, and keys to judgment. (OF-38)

**21.2.5.** Mann presents a color forecast for 1954. The impact of various magazines on color trends in home decoration is described. Color is being de-emphasized in favor of white, neutrals and pastels. (APJ-6)

**21.2.6.** Hunter discusses the practical application of color theory to paint manufacture. The field of color is a broad one, and many problems enter into the introduction of color in the paint production picture. (APJ-36)

**21.2.7.** Few of us realize the important part color cards, chips, books, and chipped displays, play in selling every kind of paint. About 95% of all trade sales and industrial maintenance finishes are sold through this medium. Painters and industrial salesmen must be equipped with an effective presentation of color.

This article discusses the production of color cards, etc., by Carl Gorr Color Card, Inc. (APJ-45)

**21.2.8.** The method of blending red, yellow and blue coloring materials to a desired color intensity and shade comprising determining the reciprocal color intensity of the given coloring components of the desired color to be obtained and then blending the colors quantitatively in the ratio of their reciprocal color intensities to produce the desired shade and hue, said reciprocal color intensity being determined by measuring the minimum critical quantity of the coloring material of unknown coloring power required to produce a coloring effect upon a substantially stronger color containing a shade modifying quantity of a weaker color other than the unknown color-

ing material other than merely deepening the color thereof, said stronger color being selected from the group consisting of bright red, bright yellow and bright blue, and said unknown color being a color of this group other than the stronger color. (USP-79)

cf: 5[illegible]2.12
5[illegible]2.15
Manufacturer:
Matherson-Selig Company

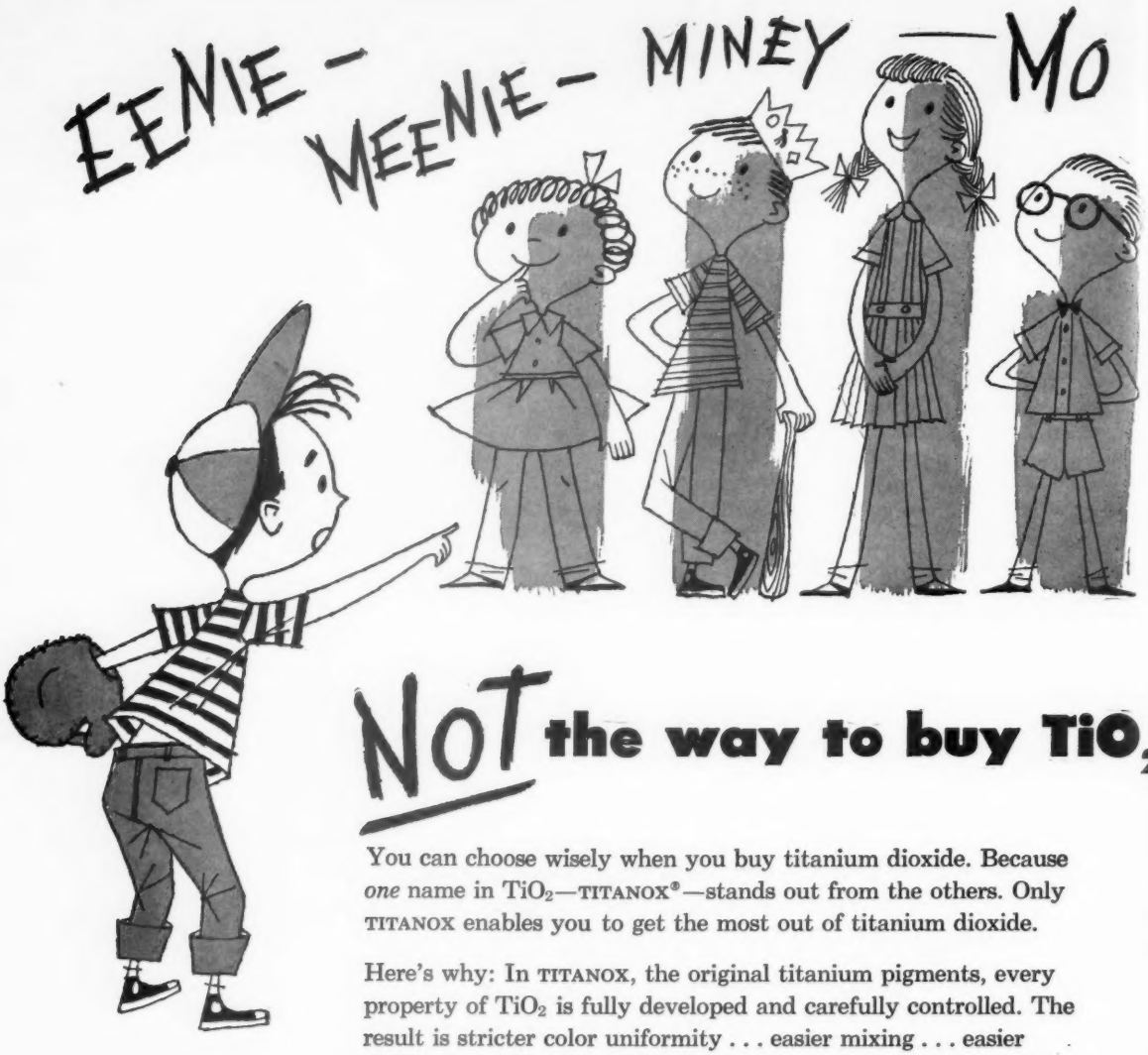
**Dyes**

**21.3.1.** Bradley & Kronowitt, in a staff-industry collaborative report, discuss the manufacture of anthraquinine vat dyes. This article describes in detail the manufacture of Cibanone Brown BR, a carbazole derivative of anthraquinone. The Ciba plant at Toms River is discussed, where more than 35 different dyestuffs can be produced. (IEC-59)

**21.3.2.** Woislawski determined, spectro-photometrically, the ionization constants of 14 basic dyes belonging to 5 chemical classes: azo, azines, xanthenes, oxazines and thiazines. The values were compared with those obtained by titration in water and in 50% unbuffered alcohol. Fairly good agreement was obtained for Nile Blue A, Bismark Brown Y, Rhodamine B, Chrysoiden Y, Neutral Red, and Pyronine B. Higher values were found by the spectrophotometric method than by the other two methods for the remaining dyes. The data indicate that the ionization constants not only vary with the method and medium, but also that the order of basicity is different in different media. (JACS-7)

**21.3.3.** A solution comprising dioxane, water, at least one oil-soluble organic dye and from 0.5% to 1.5% by weight of diethyl aminoethanol. (USP-52)

cf: 21.1.11
39.1.44
Manufacturers:
American Cyanamid Company
Arnold, Hoffman & Company, Inc.
Ciba Company, Inc.
E. I. duPont de Nemours & Company, Inc.
Eastman Chemical Products, Inc.
General Dyestuff Corporation
Peerless Color Company, Inc.

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## CHAPTER 22

# WHITE PIGMENTS

### General

**22.1.1.** Melsheimer reviews, in a general way, the existing test methods for tinting strength of white pigments. The philosophy of testing opaque white pigments for tinctorial strength is considered and factors influencing the relative strength discussed. Relative tinting strength tests should be made maintaining equal opaque white pigment volume concentration in all comparative tests by incorporating, where necessary, a substantially transparent extender with highly opaque pigments, like pure $TiO_2$, so that the evaluation is made at normal commercial concentrations. Also, to be meaningful, comparative tests must be carried out at equal opaque pigment volume concentration. (ASTM-5)

**22.1.2.** A pigment consisting essentially of lead and magnesium compounds in chemical association resulting from reaction of lead oxide and magnesium carbonate in the presence of water, the said pigment having a lead content of from approximately 20 to 70% by weight and being characterized by whiteness comparable to the whiteness of basic carbonate white lead, and a higher bulking value than basic carbonate white lead. (USP-122)

cf 21.1.8
50.2.7

### Titanium Dioxide

**22.2.1.** Anderson reviews progress and recent developments in titanium dioxide pigments. The rutile crystal structure is foremost because it best functions in the essential effects of a white pigment namely to whiten, brighten, opacify and protect. (PVP-2)

**22.2.2.** Weber describes the titanium operations at Sorel, Quebec. The story of the Lac Tio project began in 1941 when a huge deposit of titanium bearing ore was discovered along the northern rim of the Gulf of St. Lawrence. Not until late in the war was anything really done to exploit the Canadian ore deposit. Locationally the entire complex of mine, shipping sites, and plant is good. In 1953, 129,823 gross tons of slag (70% TiO2 were shipped, and the full benefits from this enterprise have not yet been fulfilled, nor will its final achievements be realized for years to come. (APJ-48)

**22.2.3.** In a process of preparing a titanium dioxide pigment possessing improved resistance to chalking wherein the particles of said pigment in aqueous slurry are coated with a hydrous aluminum oxide, the weight of said oxide as $Al_2O_3$ being about 0.5% to about 5% of the weight of said pigment, and said coated particles are then heated, the step of heating the thus coated pigment between about 500° C. and the higher temperature at which the pigment particles increase in size, until the hydrous aluminum oxide is at least partially dehydrated. (USP-100)

**22.2.4.** The American Cyanamid Company has issued Calco Technical Bulletin No. 905 on Unitane OR-640 Titanium Dioxide Pigment—A highly chalk resistant type for exterior house paints, enamels, lacquers and all tinted exterior finishes.

**22.2.5.** The American Cyanamid Company has issued Calco Technical Bulletin No. 906—Dispersion of Titanium Dioxide Using the Intensive Mixing Procedure.

**22.2.6.** The Titanium Pigment Corporation has issued a total of 64 reprints in their series "Technical Tips from Titanox".

cf: 21.1.11
22.3.2
35.5.3
36.6.1
38.1.5

Manufacturers:
American Cyanamid Company
E. I. duPont de Nemours & Company, Inc.
The Glidden Company
Titanium Pigment Corp.

### Zinc Sulphide & Zinc Oxide

**22.3.1.** Werthan reviews progress and recent developments in zinc pigments. Included are zinc sulphide and zinc oxide as white pigments and zinc oxide-zinc dust and zinc chromate as metal-protective pigments. (PVP-1)

**22.3.2.** A new photo-electric method has been described by Drs. W. Grassmann and H. Clausen of the Sachtleben A. G. research department. The accuracy of the measurements is of the same order as with the usual methods, namely ±2%. However the photoelectric method has the great advantage of being objective, and requires only one preparation of sample and measurement. (PM-14)

**22.3.3.** The New Jersey Zinc Sales Company (Inc.) has issued Service Technical Bulletin listing formula H-34200-YE: Iron Oxide —Zinc Oxide Ready Mixed Paint for Priming and Finishing Wood & Metal Surfaces.

Manufacturers:
American Zinc Sales Company
The Eagle-Picher Lead Company
The Glidden Company
The New Jersey Zinc Company
St. Joseph Lead Company
Smith Chemical & Color Company

## White Lead

**22.4.1.** White lead pigments are reviewed in an article by the Research Dept. of the National Lead Co. There are a number of lead compounds from which the paint chemist may choose for study to improve the life of paint films. (PVP-3)

cf: 22.3.2
Manufacturers:
The Eagle-Picher Lead Company
National Lead Company

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CHAPTER 23

# EXTENDER PIGMENTS

### General

**23.1.1.** Wheeler reviews extender pigments. Advances have changed the status of extenders. No longer are they merely fillers, inerts to cheapen cost but they are prime factors in the excellent performance of paints today. (PVP-8)

**23.1.2.** A panel discussion on developments in extender pigment was held at New York University (March 24, 1954). The effect of such factors as particle size and shape, surface characteristics and lack of opacifying action were illustrated and discussed. The acicular and lamellar are the only two shapes that might be considered to have a tendency to reinforce a paint film. It is also possible to control the consistency of paints by the proper choice of size and shape of a particular extender pigment. (PVP-33)

**23.1.3.** Johnson discusses the need for extenders. In describing paint pigments the terms "inert", "extender", and "filler" are commonly thought to refer to materials used only to lower the quality and cost of finishes in which they are used. Sometimes this is true, but more often, their use is beneficial, and in many cases vital to the formulation of a product of sufficiently high quality to meet requirements. Extenders control porosity, mica increases weathering resistance, talc is used to control the flow characteristics of paint, extenders are vital to production of flat and semi-gloss paints, mica reduces penetration into the film. (CPVM-10)

cf: 19.4.12
19.4.17

### Mica

**23.2.1.** The Wet Ground Mica Association, Inc. has issued Technical Bulletin No. 15—Studies on the Behavior of Mica as a Pigment Material in Latex Paints. (Part II).

**23.2.2.** The Wet Ground Mica Association, Inc. has issued Technical Bulletin No. 16—Studies on the Behavior of Mica as a Pigment Material in Latex Paints—PartIII.

**23.2.3.** The Wet Ground Mica Association, Inc. has issued Technical Bulletin No. 17—Studies on the Effect of Mica in Latex Alkyd Paints.

**23.2.4.** The Wet Ground Mica Association, Inc., has issued Technical Bulletin No. 18—The Use of Wet Ground Mica in Vinyl Acetate Co-Polymer Latex Paint—Part I.

**23.2.5.** The Wet Ground Mica Association, Inc., has issued Technical Bulletin No. 19—The Use of Wet Ground Mica in Vinyl Acetate Co-Polymer Latex Alkyd Paint—Part II.

cf: 23.1.2
Manufacturers:
Concord Mica Corporation
The English Mica Company
Franklin Mineral Products Company
Hayden Mica Company
Mineralite Sales Corporation
U. S. Mica Company, Inc.

### Silica

**23.3.1.** That buzz of activity in the ultra-fine silica field has already resulted in one new plant and several new products. More may be in the offing. Godfrey L. Cabot, Dow Corning, DuPont, General Electric, Columbia-Southern, and Monsanto are all in there pitching. (CE-6)

**23.3.2.** The Davison Chemical Company has issued Product Data Sheets describing properties and uses of Syloid 72, 244, & 978, silica pigment, silica gel and synthetic finely-sized silica.

**23.3.3.** Johns-Manville Products Corporation has issued 16-page booklet describing properties and uses of Johns-Manville Celite flatting agents and pigment extenders. Celite inert diatomite pigments step up performance of protective and decorative coatings.

**23.3.4.** The Monsanto Chemical Company has issued 16-page bulletin describing properties and uses of Santocel 54 for flatting. A preliminary bulletin (I-125) was issued earlier in the year describing this silica aerogel extender and flatting pigment.

Manufacturers:
The Davidson Chemical Corporation
Dow Corning Corporation
Great Lakes Carbon Corporation
Innis, Speiden & Company, Inc.
Johns-Manville Products Corp.
Monsanto Chemical Company
Smith Chemical & Color Company
Tamms Industries, Inc.
C. K. Williams & Company

### Calcium Carbonate

**23.4.1.** McCleary & Kummer report on calcium carbonate extender pigments in exterior masonry paints. The paper includes a) a systematic evaluation of the various grades of ground calcium carbonate; b) a formulation study in both whites and tints of low and high P.V.C. covering two different grades of ground calcium carbonate having low absorption properties; c) a critical evaluation in whites and tints of ground pigments, similarly produced from high quality calcite originating from widely different geographical sources; d) a critical evaluation of preferred

exterior white house paints containing only $CaCO_3$ as extender pigment against seven first quality self cleaning whites; e) a study in which several grades of $CaCO_3$ were formulated into white and tinted exterior paints where other vehicles replace a part or all of the linseed oil commonly used; f) a study in which ground $CaCO_3$ or $CaCO_3$ in combination with varying amounts of a high brightness thin flake mica were used along with varied amounts of 35% Pb-ZnO or with acicular ZnO; g) a series of six data tables illustrating the type of formulations which went on exposure during the summer of 1952.

The conclusions drawn are as follows:

1. Ground calcium carbonate pigments can be quite successfully used in the manufacture of high quality exterior house paints which have very favorable raw material costs.

2. Ground calcium carbonate pigments which contain substantially no particles above the 25 micron range and yet display low absorption give the best overall results in exterior house paints.

3. The use of ground calcium carbonate as the major or sole extender pigment, renders it unnecessary to use the customary quantities of Pb-ZnO or acicular ZnO in order to have satisfactory mildew resistance in exterior house paints. (OD-1)

**23.4.2.** The Witco Chemical Company has issued Bulletin P-3 describing Witcarb R in Enamels-Improvement of Gloss and Body. Witcarb R is an ultrafine precipitated calcium carbonate.

**23.4.3.** The Witco Chemical Company has issued Bulletin W-1 describing Witcarb Fillers for Polyester Resins. Witcarb is a finely divided precipitated calcium carbonate.

**23.4.4.** The Witco Chemical Company has issued Bulletin #54-3 describing the use of Witcarb pure calcium carbonate in paints

**23.4.5.** The Wyandotte Chemicals Corporation has issued 24-page Technical Bulletin on Purecal in Paints. Use of calcium carbonate in paints is discussed.

cf: 23.1.2
35.5.3
38.3.1

Manufacturers:
Carbola Chemical Company
Diamond Alkali Company
National Lead Company
Smith Chemical & Color Company
Tamms Industries, Inc.
C. K. Williams & Company
Witco Chemical Company
Wyandotte Chemicals Corp.

### Barytes

**23.5.** (No Abstracts)

Manufacturers:
National Lead Company
Smith Chemical & Color Company
C. K. Williams & Company

### Magnesium Silicate

**23.6.** (No Abstracts)

Manufacturers:
Innis, Speiden & Company, Inc.
Kraft Chemical Company, Inc.
Smith Chemical & Color Company
Tamms Industries, Inc.
R. T. Vanderbilt Company

### Aluminum Silicate

**23.7.** (No Abstracts)

Manufacturers:
Burgess Pigment Company
Innis, Speiden & Company, Inc.
Minerals & Chemicals Corp. of America

### Calcium Metasilicate

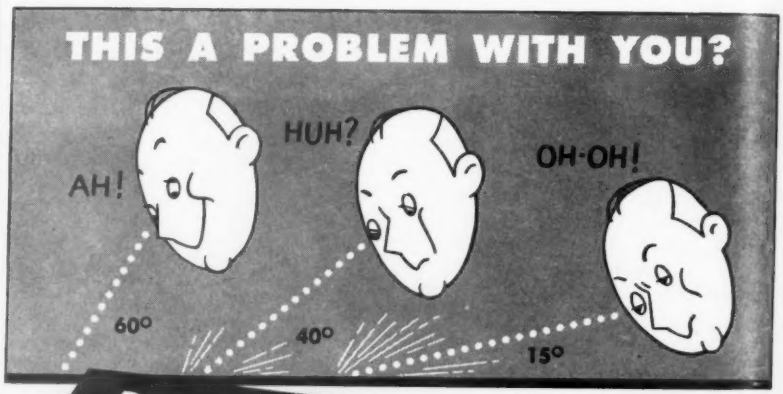
**23.8.** (No Abstracts)

Manufacturer:
Godfrey L. Cabot, Inc.

### Clay

**23.9.** (No Abstracts)

Manufacturers:
Georgia Kaolin Co.
H. C. Spinks Clay Company, Inc.
R. T. Vanderbilt Company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## CHAPTER 24

# IRON OXIDES

### General

**24.1.1.** Cauterman discusses the manufacture of iron oxide pigments. More synthetic iron oxide pigments are being used as improved manufacturing techniques turn out a better product. (CPVM-37)

### Yellow

**24.2.** (No Abstracts)

Manufacturers:
Columbian Carbon Company
Mineral Pigments Corp.
Reichard-Coulston, Inc.
Smith Chemical & Color Company
Tamms Industries, Inc.
C. K. Williams & Company

### Red

**24.3.** (No Abstracts)

Manufacturers:
Columbian Carbon Company
Mineral Pigments Corp.
Reichard-Coulston, Inc.
Smith Chemical & Color Company
Tamms Industries, Inc.
C. K. Williams & Company

### Tan

**24.4.** (No Abstracts)

Manufacturers:
Columbian Carbon Company
Mineral Pigments Corporation

### Brown

**24.5.** (No Abstracts)

Manufacturers:
Columbian Carbon Company
Mineral Pigments Corp.
Reichard-Coulston, Inc.
Smith Chemical & Color Company
C. K. Williams & Company

### Black

**24.6.** (No Abstracts)

Manufacturers:
Columbian Carbon Company
Mineral Pigments Corp.
Smith Chemical & Color Company
C. K. Williams & Company

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## CHAPTER 25

# RED PIGMENTS

### General

**25.1.1.** The Standard Ultramarine & Color Company has issued 4 technical bulletins describing properties and uses of Molora Maroon RE-6305, Molora Maroon RE-6370, BON Maroon Medium RM-6340, and Concord Maroon RE-6375. These are all BON type toners.

**25.1.2.** The Standard Ultramarine & Color Company has issued a technical bulletin describing properties and uses of Dixie Reds for Protective and Decorative Coatings. These are permanent BON toners.

**25.1.3.** The Standard Ultramarine & Color Company has issued technical bulletin on Duratone Reds, a series of new organic red pigments developed as an outgrowth of the development of a new type manganese BON Maroon Toner.

cf: 21.1.3
21.1.8
21.1.11
38.1.5
50.2.7

Manufacturers:
American Cyanamid Company
Ansbacher-Siegle Corp.
E. I. duPont de Nemours & Company, Inc.
Fine Colors Company
General Color Company
The Glidden Company
Holland Color & Chemical Company
Imperial Paper & Color Corp.
Kentucky Color & Chemical Company
Mineral Pigments Corp.
The Sherwin-Williams Company
Smith Chemical & Color Company
Standard Ultramarine & Color Company

### Toluidine Red

**25.2.1.** The Standard Ultramarine & Color Company has issued data sheet describing properties of High-Gloss Toluidine Toners.

cf: 21.1.3

Manufacturers:
American Cyanamid Company
Ansbacher-Siegle Corp.
E. I. duPont de Nemours & Co., Inc.
Fine Colors Company
Holland Color & Chemical Company
Imperial Paper & Color Corp.
Kentucky Color & Chemical Company
Mineral Pigments Corp.
The Sherwin-Williams Company
Standard Ultramarine & Color Company

### Lithol Red

**25.3.** (No Abstracts)

cf: 21.1.3
Manufacturers:
American Cyanamid Company
Ansbacher-Siegle Corp.
E. I. duPont de Nemours & Company, Inc.
Holland Color & Chemical Company
Imperial Paper & Color Corp.
Kentucky Color & Chemical Company
Standard Ultramarine & Color Company

### Para Red

**25.4.** (No Abstracts)

cf: 21.1.3
Manufacturers:
American Cyanamid Company
Ansbacher-Siegle Corp.
E. I. duPont de Nemours & Company, Inc.
Holland Color & Chemical Company
Imperial Paper & Color Corp.
Kentucky Color & Chemical Company
Standard Ultramarine & Color Company

### Cadmium Red

**25.5.** (No Abstracts)

cf: 26.3.1
Manufacturers:
American Cyanamid Company
General Color Company
Imperial Paper & Color Corp.
Kentucky Color & Chemical Company
Smith Chemical & Color Company

## CHAPTER 26

# YELLOW AND ORANGE PIGMENTS

### General

**26.1.** (No abstracts)

cf: 21.1.8
21.1.11
50.2.7
Manufacturers:
American Cyanamid Company
Ansbacher-Siegle Corp.
E. I. duPont de Nemours & Co., Inc.
Fine Colors Company
The Glidden Company
The Harshaw Chemical Company
Holland Color & Chemical Company
Imperial Paper & Color Corp.
Kentucky Color & Chemical Company
Mineral Pigments Corp.
The Sherwin-Williams Company
Smith Chemical & Color Company
Standard Ultramarine & Color Company

### Chrome Yellow

**26.2.1.** Kentucky Color & Chemical Co., Inc. has issued Customer Service Department Report on Grellow #3850, a green-shade, light chrome yellow.

cf: 21.1.2
38.1.5
Manufacturers:
American Cyanamid Company
Ansbacher-Siegle Corp.
E. I. duPont de Nemours & Co., Inc.
Imperial Paper & Color Corp.
Kentucky Color & Chemical Company
Mineral Pigments Corp.

### Cadmium Yellow

**26.3.1.** Pigments derived from cadmium sulphide, cadmium sulphoselenides and co-precipitants are described by Curtis and Wright. Methods of manufacture are outlined, and data given on analytical methods both qualitative and quantative, color and particle size distribution.

The uses of these pigments in paints, artists' colors, rubber, plastics, printing inks, wallpaper, leather, glass and vitreous enamels are briefly discussed. (JOCCA-18)

Manufacturers:
American Cyanamid Company
Imperial Paper & Color Corp.
Kentucky Color & Chemical Company
Smith Chemical & Color Company

### Organic Oranges

**26.4.** (No abstracts)

cf: 21.1.3
Manufacturers:
American Cyanamid Company
Ansbacher-Siegle Corp.
E. I. duPont de Nemours & Co., Inc.
Holland Color & Chemical Company
Imperial Paper & Color Corp.
Kentucky Color & Chemical Company
Mineral Pigments Corp.
The Sherwin-Williams Company
Standard Ultramarine & Color Company

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## CHAPTER 27

# GREEN PIGMENTS

### General

**27.1.** (No abstracts)

cf: 21.1.8
21.1.11
Manufacturers:
American Cyanamid Company
Ansbacher-Siegle Corp.
E. I. duPont de Nemours & Co., Inc.
Holland Color & Chemical Company
Imperial Paper & Color Corp.
Kentucky Color & Chemical Company
Mineral Pigments Corp.
The Sherwin-Williams Company
Smith Chemical & Color Company

### Chrome Green

**27.2.** (No abstracts)

cf: 21.1.2
Manufacturers:
American Cyanamid Company
Ansbacher-Siegle Corp.
E. I. duPont de Nemours & Co., Inc.
Imperial Paper & Color Corp.
Kentucky Color & Chemical Company
Mineral Pigments Corp.
Smith Chemical & Color Company

### Phthalocyanine Green

**27.3.1.** The method of producing a tinctorially strong, metallized phthalocyanine pigment in a finely divided pigmentary state which comprises subjecting a metallized phthalocyanine pigment to grinding in the presence of an organic liquid with a solid grinding aid having a surface area of at least 0.14 square meter per gram, the quantity of organic liquid present being sufficient to convert the pigment-grinding aid mixture to a doughy mass, and thereafter isolating the pigment from the ground mass. (USP-95)

**27.3.2.** New York Color & Chemical Co. (Inc.) issued a bulletin describing Nycolime Colors—specially designed for the cement and allied industries.

cf: 21.1.3
38.1.5
Manufacturers:
American Cyanamid Company
Ansbacher-Siegle Corp.
E. I. duPont de Nemours & Co., Inc.
Fine Colors Company
General Dyestuff Corp.
Holland Color & Chemical Company
Imperial Paper & Color Corp.
Kentucky Color & Chemical Company
Mineral Pigments Corp.
New York Color & Chemical Company
Standard Ultramarine & Color Company

### Chromium Oxide

**27.4.** (No abstracts)

Manufacturers:
Imperial Paper & Color Corp.
Mineral Pigments Corp.
C. K. Williams & Company
Smith Chemical & Color Company

CHAPTER 28

# BLUE AND VIOLET PIGMENTS

### General

**28.1.** (No abstracts)

cf: 21.1.8
21.1.11
Manufacturers:
American Cyanamid Company
Ansbacher-Siegle Corp.
E. I. duPont de Nemours & Co., Inc.
Imperial Paper & Color Corp.
Kentucky Color & Chemical Company
The Sherwin-Williams Company
Smith Chemical & Color Company
Standard Ultramarine & Color Company

### Phthalocyanine Blue

**28.2.1.** Broullard & Mutaffis studied the crystallization of phthalocyanine blue. This crystallization tendency contributes to loss of strength and brilliance experienced on aging paint, enamel or lacquer systems containing phthalocyanine blue. Further study has shown that certain solvents and particularly the aromatics in the systems are responsible for this crystallization. The realistic evaluation of phthalocyanine blue with reference to solvent stability cannot be made by simple microscopic examination of the pigment in a solvent. This evaluation must be done by a test closely related to end use and preferably measured by sensitive instrument such as a spectrophotometer. (PVP-43)

**28.2.2.** Kentucky Color & Chemical Co., Inc. has issued Customer Service Department Report on Zulu Blue N-F No. 4857 a non-flocculating phthalocyanine blue.

cf: 21.1.3
27.3.1
Manufacturers:
American Cyanamid Company
Ansbacher-Siegle Corp.
E. I. duPont de Nemours & Co., Inc.
Fine Colors Company
General Dyestuff Corp.
Holland Color & Chemical Company
Imperial Paper & Color Corp.
Kentucky Color & Chemical Company
Mineral Pigments Corp.
New York Color & Chemical Company
Standard Ultramarine & Color Company

### Ultramarine Blue

**28.3.1.** Kumins discusses ultramarine blue. Following a short history he discusses its uses, color characteristics and comparison with other blues, structural chemistry, method of manufacture, later developments, chemistry of the primary and secondary calcination steps, and special ultramarines. (IR-3)

cf: 38.1.5
Manufacturers:
American Cyanamid Company
Smith Chemical & Color Company
Standard Ultramarine & Color Company

### Iron Blue

**28.4.** (No abstracts)

Manufacturers:
American Cyanamid Company
Ansbacher-Siegle Corp.
E. I. duPont de Nemours & Co., Inc.
Imperial Paper & Color Corp.
Kentucky Color & Chemical Company
Mineral Pigments Corp.
Standard Ultramarine & Color Company

### Organic Violets

**28.5.** (No abstracts)

Manufacturers:
American Cyanamid Company
Ansbacher-Siegle Corp.
Holland Color & Chemical Company

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| RAVENS* | the all purpose black — standard for color — good hiding and dispersion — wide application. |
| | densed form for cleaner handling and less storage space—try the black that contributes better leveling qualities to finishes. |
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| MAPICO TANS | three rich shades which when cut with white produce many desirable tints. |
| MAPICO BROWNS | two entirely new iron oxide types on the reddish yellow side, with unusual ability to withstand high temperatures. |
| MAPICO BLACK | strong colors which alone produce richer brown paints than any combination of yellow, red and black iron oxides. |
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## CHAPTER 29

# BLACK PIGMENTS

### General

**29.1.** (No abstracts)

cf: 21.1.8
21.1.11
Manufacturers:
Ansbacher-Siegle Corp.
Godfrey L. Cabot, Inc.
Mineral Pigments Corp.
Smith Chemical & Color Company

### Carbon Black

**29.2.1.** Carbon blacks are reviewed in an article by the Technical Service Dept. of Binney & Smith Co. Today the paint & lacquer industries have available a greater variety of carbon blacks than ever before to fit the special demands of the formulator. (PVP-4)

**29.2.2.** The developments and refinements in the manufacture and utilization of carbon black over the past 25 years have led to a considerable increase in their use as pigments. In the first of a series of articles, Venuto reviews the manufacturing history, the types and the properties of carbon black. (PM-55)

**29.2.3.** Venuto, in the second of the series of articles on carbon black, considers the type of carbon black and the vehicle in which it is to be incorporated. They are important factors in the manufacture of paint. He also deals with the selection of the black for a particular use, the setting up of control standards and the storage and handling of these products. (PM-58)

**29.2.4.** Consolidated Carbon takes option on new carbon black process, plans construction of 10 plants. Commercial exploitation of the Lynn Furmatic method for making carbon black has moved a step further. The unproved process produces two types of commercial carbon black in the ink and rubber black ranges. (CEN-21)

**29.2.5.** After two years in development, a new carbon black process is ready to make its commercial debut. A novel spherical heating unit is the nub of the operation, called the Lynn Furmatic process, now somewhat modified from its original outline. Carbon black handicappers give the process due credit, but concede it only an outside chance of finishing in the money. (CW-21)

**29.2.6.** The combination of high-viscosity milling and specific dispersing agents yields the highest degree of true colloidal dispersion with the attendent brilliant gloss and blackness. This is one conclusion by Venuto, who in this third part of his article reviews the subject of milling procedure and makes further reference to solubility factors and to the influence of specific dispersing agents. (PM-63)

**29.2.7.** The problems encountered with or attributed to the use of carbon blacks as pigments are reviewed by Venuto in this the last part of his article. He also considers the final operations in the manufacture of the protective coating, and the tests which should be applied to ensure a satisfactory product. (PM-70)

**29.2.8.** The Acheson Dispersed Pigments Company has issued Technical Bulletin No. 100 on "The Function of Carbon Black in the Protection of Exposed Polyethylene."

**29.2.9.** Godfrey L. Cabot, Inc. has issued the second edition of 100-page book "Cabot Carbon Blacks Under the Electron Microscope." Electron micrographs and particle size data are presented for the various carbon blacks the company manufactures.

cf: 35.5.3
Manufacturers:
Binney & Smith Inc.
Godfrey L. Cabot, Inc.
Mineral Pigments Corp.
Sid Richardson Carbon Company
Smith Chemical & Color Company
United Carbon Company, Inc.
R. T. Vanderbilt Company

### Bone Black

**29.3.** (No abstracts)

cf: 38.1.5
Manufacturers:
Mineral Pigments Corp.
Smith Chemical & Color Company

### Lampblack

**29.4.** (No abstracts)

Manufacturers:
General Carbon Company
Mineral Pigments Corp.
Monsanto Chemical Company
Smith Chemical & Color Company
C. K. Williams & Company

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| | good covering where low oil absorption is required. |

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Synthetic colors with light stability, high covering power, and acid and alkali stability.

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| | a low oil absorption black for tough finishes and tinting. |

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500 TONS OF SMOKE A DAY

CHAPTER 29

# BLACK PIGMENTS

### General

**29.1.** (No abstracts)

cf: 21.1.8
21.1.11
Manufacturers:
Ansbacher-Siegle Corp.
Godfrey L. Cabot, Inc.
Mineral Pigments Corp.
Smith Chemical & Color Company

### Carbon Black

**29.2.1.** Carbon blacks are reviewed in an article by the Technical Service Dept. of Binney & Smith Co. Today the paint & lacquer industries have available a greater variety of carbon blacks than ever before to fit the special demands of the formulator. (PVP-4)

**29.2.2.** The developments and refinements in the manufacture and utilization of carbon black over the past 25 years have led to a considerable increase in their use as pigments. In the first of a series of articles, Venuto reviews the manufacturing history, the types and the properties of carbon black. (PM-55)

**29.2.3.** Venuto, in the second of the series of articles on carbon black, considers the type of carbon black and the vehicle in which it is to be incorporated. They are important factors in the manufacture of paint. He also deals with the selection of the black for a particular use, the setting up of control standards and the storage and handling of these products. (PM-58)

**29.2.4.** Consolidated Carbon takes option on new carbon black process, plans construction of 10 plants. Commercial exploitation of the Lynn Furmatic method for making carbon black has moved a step further. The unproved process produces two types of commercial carbon black in the ink and rubber black ranges. (CEN-21)

**29.2.5.** After two years in development, a new carbon black process is ready to make its commercial debut. A novel spherical heating unit is the nub of the operation, called the Lynn Furmatic process, now somewhat modified from its original outline. Carbon black handicappers give the process due credit, but concede it only an outside chance of finishing in the money. (CW-21)

**29.2.6.** The combination of high-viscosity milling and specific dispersing agents yields the highest degree of true colloidal dispersion with the attendent brilliant gloss and blackness. This is one conclusion by Venuto, who in this third part of his article reviews the subject of milling procedure and makes further reference to solubility factors and to the influence of specific dispersing agents. (PM-63)

**29.2.7.** The problems encountered with or attributed to the use of carbon blacks as pigments are reviewed by Venuto in this the last part of his article. He also considers the final operations in the manufacture of the protective coating, and the tests which should be applied to ensure a satisfactory product. (PM-70)

**29.2.8.** The Acheson Dispersed Pigments Company has issued Technical Bulletin No. 100 on "The Function of Carbon Black in the Protection of Exposed Polyethylene."

**29.2.9.** Godfrey L. Cabot, Inc. has issued the second edition of 100-page book "Cabot Carbon Blacks Under the Electron Microscope." Electron micrographs and particle size data are presented for the various carbon blacks the company manufactures.

cf: 35.5.3
Manufacturers:
Binney & Smith Inc.
Godfrey L. Cabot, Inc.
Mineral Pigments Corp.
Sid Richardson Carbon Company
Smith Chemical & Color Company
United Carbon Company, Inc.
R. T. Vanderbilt Company

### Bone Black

**29.3.** (No abstracts)

cf: 38.1.5
Manufacturers:
Mineral Pigments Corp.
Smith Chemical & Color Company

### Lampblack

**29.4.** (No abstracts)

Manufacturers:
General Carbon Company
Mineral Pigments Corp.
Monsanto Chemical Company
Smith Chemical & Color Company
C. K. Williams & Company

## CHAPTER 30

# METALLIC FLAKES AND POWDERS

### General

**30.1.1.** A process for treating commercial, initially fatty-lubricated, lamellar copper-base bronze powder, for rendering said powder resistant to tarnish discoloration, comprising confining such a powder within an enclosure, maintaining in said enclosure a treating gaseous atmosphere, heating the powder at temperatures above 300° C. and below the sintering temperature of the particular powder being treated, continuing the heating until the initial fatty lubricant has been decomposed into a hard, transparent, invisible film covering the individual particles of the powder, and using a treating atmosphere having no decarburizing action on the particle's film, said atmosphere consisting of a gas chosen among the hydrocarbon gases, nitrogen, helium, carbon monoxide and also carbon dioxide in presence of organic matter vapors. (USP-78)

cf: 21.1.8
39.1.1
50.3.1
Manufacturers:
Magna Mfg., Co., Inc.
Metals Disintegrating Company, Inc.
United States Bronze Powder Works

**30.2.1.** Knoll reviews progress and recent developments in aluminum pigments. In the seventeen years since the Hall Process has been in commercial use, the list of aluminum pigments available to the coatings industry has increased from two or three to about 24. This is a result of the needs for specialized products each designed to accomplish a specific result. (PVP-7)

**30.2.2.** Frederick & Woosley discuss tests made to determine those characteristics which contribute to the optimum leafing of an asphalt aluminum roofing paint or coating.

The leafing power of a vehicle has a much greater range in the 11-15 second and the 15-20 second viscosities (#4 Ford Cup) than in the 21-25 seconds and 26-30 second viscosities. Its leafing power is affected by changes of specific gravity within the lower viscosities much greater than in the higher viscosities.

The use of a high solvency, high specific gravity thinner in reducing the asphalt base for an asphalt aluminum paint results in a better leafing product and a better paint film.

As with oleo-resinous varnishes, the higher the specific gravity and the lower the viscosity, combined with the proper evaporation rate, the better will be the leafing of an aluminum asphalt roof-coating vehicle. (PVP-45)

**30.2.3.** Rethwisch, et al, studied reflectivity of aluminum pigments and paint. Coarse grades show better reflectivity than fine grades. Total reflectivity values for coarse grades is not dependent on inclusion of specularly reflected light. The five grades show an average of 5-6% difference under same conditions. As pigments become finer, "whiteness" decreases and specular reflectivity increases. Specular reflectivity is a combination of fineness of film (or pigment) and degree of polish of the pigment. Whiteness or apparent reflectivity is a combination of roughness of film (or pigment) and lack of polish of the pigment. (POCR-9)

**30.2.4.** Babcock & Rethwisch discuss the classification of aluminum pigments; ie into leafing and non-leafing pigments. The leafing type consists primarily of an aluminum flake and may be in either paste or powder form. The non-leafing type may be either a flake or granular nature and may also be obtained in either paste or powder form.

The author discusses the selection of aluminum pigments, vehicles for aluminum pigments, application, and storage. (POCR-25)

**30.2.5.** The Aluminum Company of America has issued revised sheets listing characteristics for the various Alcoa Aluminum Pastes and Powders.

Manufacturers:
Aluminum Company of America
Reynolds Metals Company

## CHAPTER 31

# LUMINOUS PIGMENTS

### General

**31.1.1.** Fluorescence is a rather unusual property of substances. Bowen attempts to explain the rarity of this property. This is due to two categories of factors, chemical reactions and internal conversion, which influence the emission of absorbed light energy. (JOCCA-31)

**31.1.2.** Varron discusses fluorescence and phosphorescence as well as less familiar aspects of luminescence, from a theoretical and practical standpoint. Included are emission spectra, physical aspects of fluorescence, polarization of fluorescence, quenching of fluorescence, constitution and fluorescence, and the applications. (IR-6)

cf: 23.3.1
Manufacturers:
Imperial Paper & Color Corp.
The New Jersey Zinc Company
Rhode Island Labs., Inc.

CHAPTER 32

# METAL PROTECTIVE PIGMENTS

### General

**32.1.1.** Blowes, et al, present a continuation of their earlier paper on zinc dust as a protective pigment.

The behavior of air-drying zinc-rich paints on rusted surfaces in air is described and principles of formulation discussed. Suggestions are made for a formulation of optimal properties.

Experiments on the use of zinc-rich paints in comparison with some other anti-corrosive compositions in sea water are described. Mention is made of the use of zinc dust in stoving and heat-resisting finishes.

The use of zinc dust-zinc oxide oil paints as primers for steel and wood is discussed and the use of the colored types of these paints suggested.

Future developments with zinc dust pigments would seem to lie in the production of finer particle materials, either of leaf or spherical form. (JOCCA-39)

**32.1.2.** Killeffer describes the evaluating of molybdate pigments as corrosion inhibitors. Molybdates in solution are known to have corrosion inhibiting properties. (POCR-24)

cf: 39.2.2

### Chromates

**32.2.1.** Wakefield reviews and discusses the use of zinc yellow in primers for metal protection. The present concept of the primer as a most important component of a protective paint system involves coordination of such factors as pigmentation with inhibitive pigments (as zinc yellow), proper choice and balance of other pigments and vehicle to give maximum adhesion to the metal surface, a good foundation for following coats, a flexible, age resistant, low permeability film, and drying or baking properties to meet the scheduling of its applications. (PVP-11)

**32.2.2.** Schleicher presents part III of his paper on protection of steel. This part covers the subject of zinc chromate for primer coats. (PIM-30)

**32.2.3.** A composite lead chromate lead silicate pigment consisting essentially of PbO, $CrO_3$, and $SiO_2$ in physico-chemical combination, said PbO, $CrO_3$ and $SiO_2$ being analytically present so that there are from 2 to 10 mols of PbO for each mol of $CrO_3$ and from 0.75 to 7.5 mols of $SiO_2$ for each mol of PbO. (USP-84)

**32.2.4.** Kentucky Color & Chemical Co., Inc. has issued Customers Service Department Report on Kentucky's Strontium Chromate No. 2821, a straight chemical salt, valuable as a new rust-inhibitive pigment.

cf: 23.3.1
39.2.1

Manufacturers:
American Cyanamid Company
Ansbacher-Siegle Corp.
E. I. duPont de Nemours & Co., Inc.
Imperial Paper & Color Corp.
Kentucky Color & Chemical Company
Mineral Pigments Corp.
Smith Chemical & Color Company

### Red Lead

**32.3.1.** Vander Valk reviews and discusses the use of red lead for metal protection. Intensive research and comparative service testing by the Lead Industries Association has resulted in the development of many outstanding red lead base metal protective primers for a variety of applications. (PVP-10)

cf: 32.1.1
39.2.9

Manufacturers:
The Eagle-Picher Lead Company
National Lead Company

### Lead Cyanamide

**32.4.1.** One of the outstanding developments in pigments during the last few years has been lead cyanamide—and this pigment is being increasingly used in European anti-rust and marine paints. A brief historical background is given along with some formulation data.

Lead cyanamide is preferably used in linseed-oil primers, because it is here that its good properties are best utilized with regard to the possibility of lead soap formation. (PM-15)

### Zinc Dust

**32.5.** (No abstracts)

Manufacturers:
National Zinc Company, Inc.
The New Jersey Zinc Company

## CHAPTER 33

# DISPERSIONS

### General

**33.1.1.** Carr discusses dispersible pigment powders. The use of organic pigments in a water paste form as distinct from a dry powdered form is growing in many of the color-using industries. In the dyeing of paper, for instance, there is a steadily growing demand for shades which combine brightness with good light fastness. This demand can only be adequately met by the use of pigments, and pigments can only be applied to paper when in the paste form. The use of dry pigment powders generally results in dyeings in which large particles of undispersed pigments are present and in which the full color value of the pigment is not obtained. The ideal dispersible pigment powder for synthetic emulsion paints should possess the following properties:

a. should be dry, free-flowing, easy to transport, store and handle.
b. should wet out and disperse readily in water or emulsions without grinding and with ordinary stirring to give a fine suspension.
c. should contain a minimum of diluent or non-pigmentary material, and these should not impair the stability or performance of emulsion paints.
d. should not be much more expensive on a color strength-price basis than the corresponding dry pigment powders or pigment pastes.
e. should be non-dusting in character—that is, on handling, there should be no problem of flying color.

(PM-11)

**33.1.2.** A pigment paste comprising water, 100 parts of a pulverulent water-insoluble pigment and from 1 to 50 parts of a salt prepared by neutralizing a copolymer of styrene and a half-ester of maleic acid with a compound taken from the group consisting of ammonia, morpholine and alkyl amines which are volatile at temperatures

The same qualities that develop gloss on top of a film contribute to adhesion on the bottom. The reduction of pigment agglomerates, and thorough pigment wetting, give the binder its best chance to do its job.

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below 100° C., the ester groups in said half-ester consisting of a mixture of methyl groups and secondary butyl groups, the ratio of methyl groups to secondary butyl groups varying from 11:89 to 48:52 mol percent. (USP-11)

**33.1.3.** A pigmented coating composition comprising an aqueous continual external phase, a dispersed pigment, a thickener, a cationic water soluble resin which is produced by reacting 1 mol of urea with from 2 to 3 mols of formaldehyde in the presence of at least one-third mol of a compound selected from the group consisting of pyridine, quinoline, water soluble aliphatic amines having at least one hydrogen attached to the amino nitrogen and hydroxy tertiary aliphatic amines, until a solution is obtained and then acidifying the mixture to a pH between 0.5 and 2.0 and immediately neutralizing to a pH of from 6.0 to 7.0; and an anionic polymeric material of the group consisting of polystyrene polyvinyl chloride and polyvinyl acetate, said anionic resin being present in an amount varying from 5% to 15% by weight based on the weight of the composition, said cationic resin being present in an amount sufficiently great to redisperse the anionic resin, the cationic resin of said composition being convertible to an insoluble state by heat. (USP-44)

**33.1.4.** The Acheson Colloids Company has issued 10-page Catalog No. 460 describing properties and uses of the various "dag" dispersions they manufacture.

**33.1.5.** The Sherwin-Williams Company has issued the second edition of their bulletin: Sherwin-Williams Colors for Latex Emulsion Paints. Dry pigments are discussed as well as dispersions of these colors in water.

cf: 21.1.3
29.2.1

Manufacturers:
Acheson Colloids Company
Acheson Dispersed Pigments Company
Aluminum Company of America
Ansbacher-Siegle Corp.
Holland Color & Chemical Company
Magna Manufacturing Company, Inc.
Metals Disintegrating Company, Inc.
Mineral Pigments Corp.
C. J. Osborn Company
Pennsylvania Color & Chemical Company
R-H-B Dispersions
Reynolds Metals Company
The Sherwin-Williams Company
Standard Ultramarine & Color Company
Vansul & Company

### Pearl Essence

**33.5.** (No abstracts)

Manufacturer:
National Lead Company

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- Celanese Solvent 901-H
- Methanol

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# SOLVENTS

## CHAPTER 34

# SOLVENTS

### General

**34.1.1.** Kunin states the behavior of ion exchange resins in nonaqueous systems is closely related to the nature of hydrocarbon chains present in the resin and to the porosity or the degree of cross linking. Ion exchange occurs to a greater extent, or more rapidly, in polar solvents than in nonpolar solvents. (IEC-23)

**34.1.2.** Ham reviews solvents for polyacrylonitrile. Solvents studied included amide-type solvents and nitro derivatives among others. (IEC-40)

**34.1.3.** Croswell discusses safety and dangers connected with solvents. Approximate maximum concentration and ventilation rate design data are given for approximately 30 common solvents. (IEC-47)

**34.1.4.** Johnson & Francis have obtained the phase diagrams and selectivity diagrams for the system benzene-heptane-diethylene glycol at temperatures varying from 25° to 175° C. The effect of water on this system also has been examined. (IEC-76)

**34.1.5.** Organic solvents are frequently used to suppress the solubility of slightly soluble salts. The selection of the organic solvent and its most effective concentration usually has been determined by trial and error methods. In this paper, Jentoft & Robinson present an objective method, based upon mathematical derivation and involving graphical analysis of solubility data. This method should be of interest in all cases involving reduction of solubility through the use of organic solvents, whether in a method of analysis or in an industrial process. (AC-15)

**34.1.6.** The Carbide & Carbon Chemicals Company has issued the 1955 Edition (24-page) of Physical Properties—Synthetic Organic Chemicals.

**34.1.7.** The Carbide & Carbon Chemicals Company has issued a 6-page chart—Solvent Selector for Coating Formulations.

cf: 5.4.1
16.1.7
38.1.1
50.3.3

### Aliphatic Hydrocarbons

**34.2.1.** Wilson, et al, studied the solvency characteristics of low odor type thinners. Conclusions drawn are as follows.

With resins of 24% phthalic anhydride content, eastern and western type thinners yield solutions of approximately equal viscosity. The low odor and odorless thinners give solutions of higher viscosity, but at concentrations normally employed, i.e., 40%, probably have little effect on the resulting viscosity of a finished product.

With resins of 30% or more phthalic anhydride, the lower viscosity resulting from the greater solvent power of western type thinner is very evident at resin concentrations of 55% or higher, becoming negligible as the solids are reduced to 40%. The low odor and odorless types yield considerably higher viscosities at all resin concentrations tested.

Thinners of the slow evaporating type yield solutions of higher viscosity than might be expected from their indicated solvent strength, the increase being more apparent at resin concentrations above 30%.

The stability of solutions of resins containing 30% or more phthalic anhydride in odorless type thinners is questionable at solid-contents of 25% and lower. (OD-8)

**34.2.2.** Larson & Low describe the alkyd reduction technique. By this technique, a number of additives added to low solvency thinners reduce the viscosity of the resin-thinner blends to brushability consistency.

Successful practical application of the technique requires that these additives have no adverse effects on the properties of the paint either prior to use or after it has been applied and the film is dry.

Of various features important to film quality, the following qualitative observations can be made:

a. Non-penetrating quality is preserved
b. Brushability is improved
c. Water resistance is not impaired
d. The film is not softened
e. Adhesion is not adversely affected
f. Drying time is not affected in enamel compositions, time to achieve ultimate hardness may be increased slightly.

(OD-24)

**34.2.3.** The Golden Gate Club made a study of the solvency characteristics of low odor type thinners. Five thinners were studied with 5 resin types. (POCR-)

**34.2.4.** Oil-based interior paints, already hurt and threatened even further by latex emulsions, look to odorless mineral spirits to help stabilize their markets. (CE-2 )

**34.2.5.** The R. J. Brown Company has issued 54-page compilation of data sheets on Bronco aliphatic and aromatic solvents. Included are data for 16 aromatics and 31 aliphatic solvents.

ETHYL ALCOHOL 2-AMINO-2-METHYL-1,3-PROPANEDIOL

BUTYL STEARATE DIBUTYL PHTHALATE

E JTYL LACTATE NITROPARAFFINS AMMONIA

AMYL ACETATE BUTYL ACETATE

RIBOFLAVIN, USP

N DERIVATIVES

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MONOMETHYLAMINE

METHANOL

ETHYL ACETATE

TRIBUTYL PHOSPHATE DIETHYL OXALATE

2-AMINO-2-METHYL-1-PROPANOL TRIMETHYLAMINE

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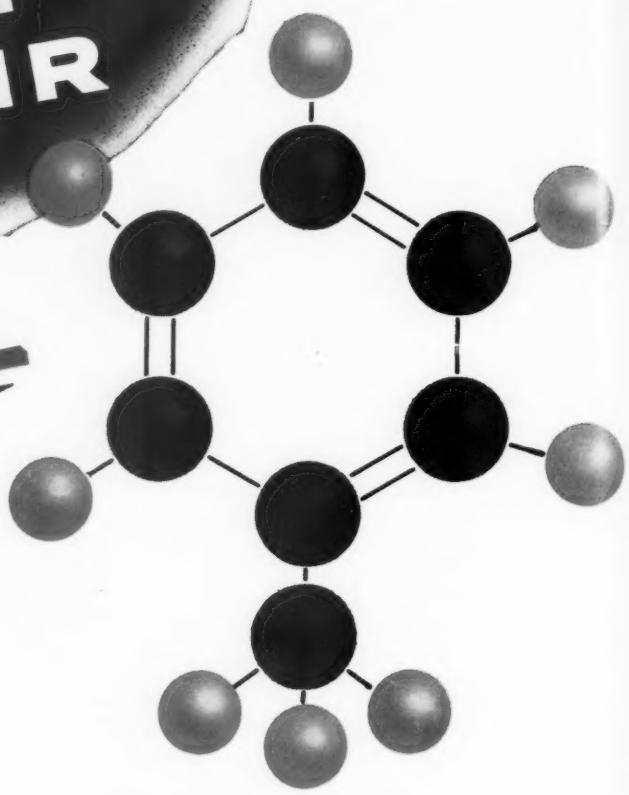

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(Subsidiary of Sinclair Oil Corporation)
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**34.2.6.** The Socony-Vacuum Oil Company, Inc. has issued a series describing Socony-Vacuum Solvents and their Uses. Included are Sovasols 1-6, 35,80, and 140.

**34.2.7.** Standard Oil of California introduced "Standard Odorless Thinner". This thinner has less odor than tap water, and far greater stability than many odorless thinners. Cost of thinner is 3½c higher than cost of conventional petroleum mineral spirits.

cf: 34.3.5
36.9.1

Manufacturers:
American Mineral Spirits Company
Anderson-Prichard Oil Company
The Atlantic Refining Company
The R. J. Brown Company
Central Solvents & Chemicals Company
Esso Standard Oil Company
Gulf Oil Corporation
Phillips Petroleum Company
Sinclair Chemicals, Inc.
Skelly Oil Company
Standard Oil Company of Calif.

### Aromatic Hydrocarbons

**34.3.1.** Xylenes hit their importance-peak during World War II when large quantities were used for aviation gasoline and lacquer solvents. More and more separated xylenes will be available as petro producers vie (with expansions and new plants) for promising polyester fibers, new film and plasticizer markets. (CW-3)

**34.3.2.** Allied's Solvay Process Division producing pure orthodichlorobenzene. Technique used could work just as well on other nuclear chlorinated aromatics like toluenes, naphthalenes and thiophenes. (CW-8)

**34.3.3.** Lower defense requirements for benzene and possible business recession may make current production goals pass demand. There are prospects of surplus. (CEN-1)

**34.3.4.** Steady rise in production of benzene, toluene, xylene from petroleum continues; xylene reaches a new high. Petroleum-derived xylene hit a new production peak of 103 million gallons in 1953. The percentage of the three major aromatics that are petroleum-derived has risen steadily over the past five years. (CEN-19)

**34.3.5.** Billmeier & Rittershausen discuss the evaporation of petroleum thinners from protective coatings.

The rate of evaporation of all thinners, including essentially pure compounds as well as very narrow cuts, decreases considerably as the evaporation progresses when non-volatile materials are present.

The rate of the viscosity build-up of the protective coating rather than rate of evaporation of the solvent affects the initial set, wet edge time and brushability. The rate of viscosity build-up is a function of the viscosity thinning power as well as the inherent evaporation rate of the thinner.

A factor affecting the rate of evaporation of the thinner is the amount of thinner spread per unit of surface covered.

The initial rate of evaporation of a volatile thinner is not exclusively a function of the initial boiling point but is affected by the other components of the thinner. (OD-35)

**34.3.6.** The Carbide & Carbon


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Chemical Company has issued 4-page bulletin describing ethyl benzene.

**34.3.7.** The Eastern States Petroleum Company, Inc. has issued 20-page catalog describing Espesol 1,2,4,5,6,7, and benzol, all aromatic solvents.

cf: 34.2.5
Manufacturers:
American Cyanamid Company
American Mineral Spirits Company
Anderson-Prichard Oil Corp.
Barrett Division
The R. J. Brown Company
Central Solvents & Chemicals Company
Eastern States Chemical Corp.
Esso Standard Oil Company
Koppers Company, Inc.
Neville Chemical Company
Oronite Chemical Company
Pan American Chemicals
Penn. Ind. Chem. Corp.
Skelly Oil Company
Standard Oil Company of Calif.
Sun Oil Company
Velsicol Corp.

### Oxygen-Containing

**34.4.1.** Carlson et al discuss the separation of oxygenated organic compounds by water extractive distillation. The differences in relative volatility under water extractive distillation conditions allows complete separations, according to class, in one operation. Thus alcohols can be separated from ketones, aldehydes, esters, ethers, and hydrocarbons. Separations within a class can also be accomplished. For example isopropyl alcohol can be separated from ethyl alcohol. In all separations within a class, the higher molecular weight compound is rendered the more volatile. (IEC-36)

**34.4.2.** Acetone makers, plagued by current declines in cellulose acetate rayon output, lacquer sales, exports, face still another headache—keener competition from more acetone via newer phenol-from-cumene route. But welcome relief may lie in new solvent and other outlets such as intermediates. (CW-18)

**34.4.3.** Jones & McCants present ternary solubility data for systems:

1-butanol-methyl 1-butyl ketone-water; 1-butyraldehyde-ethyl acetate-water; and 1-hexane-methyl ethyl ketone-water. (IEC-83)

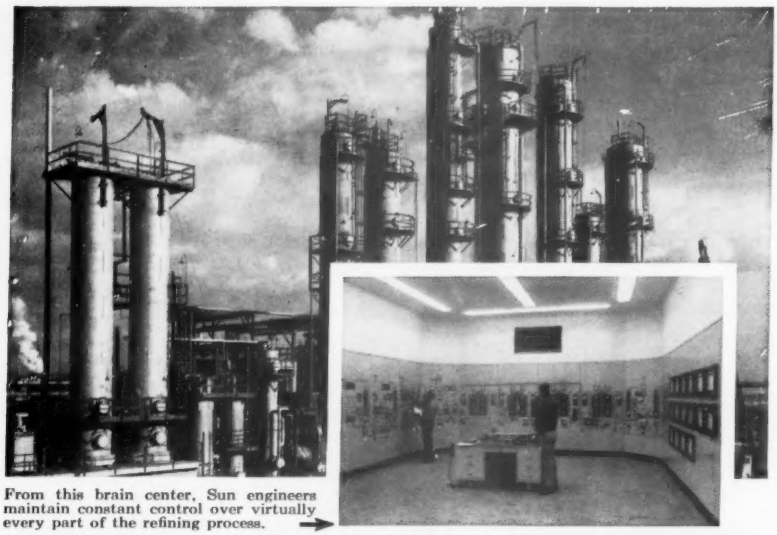
**34.4.4.** Brey presents analysis data for the ternary system: isopropyl alcohol-ispropyl ether-water. Numerical results are presented for mixtures at 5% composition intervals throughout the region of miscibility, and, where possible, these are compared with data from the literature. (AC-11)

**34.4.5.** Key to a way to rid isopropyl alcohol of the undesirable odor which often degrades the product is a high-pressure distillation to get top-purity propylene. (CE-10)

**34.4.6.** '54 outlook for alcohol & solvents—most competitive year in over a decade. Price reductions seem inevitable. Over the years, alcohols & solvents have reached their saturation point. With the exception of the growth factor, overall demand will not vary more than 10 percent either way. In two or three years, production curtailment will be necessary to avoid complete price demoralization. Balance between supply & demand should return with the growth of the country and its technological developments. (CE-13)

**34.4.7.** The American Monomer Corp. has issued Bulletin M-1 describing Methac Solvent, composed of a blend of methyl acetate and methanol.

**34.4.8.** The Wyandotte Chemical Corporation has issued 73 page book describing properties

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and uses of glycols and related products.

**34.4.9.** The Commercial Solvents Corp. has issued Technical Data Sheet No. 21 describing Ethyl Alcohol, pure-denatured-proprietory solvents.

**34.4.10.** Ethyl Acetate-new technical data sheet describing properties and uses, by Commercial Solvents Corp., 260 Madison Ave., New York 16, N. Y.

Manufacturers:
American Monomer Corp.
Baird Chemical Corp.
Carbide & Carbon Chemicals Company
Celanese Corp. of America
Commercial Solvents Corp.
The Dow Chemical Company
Eastman Chemical Products, Inc.
Enjay Company, Inc.
General Aniline & Film Corp.
Monsanto Chemical Company
The Quaker Oats Company
Sharples Chemicals, Inc.
Shell Chemical Corp.
Wyandotte Chemicals Corp.

### Halogen-Containing

**34.5.** (No abstracts)

Manufacturers:
Diamond Alkali Company
The Dow Chemical Company
E. I. duPont de Nemours & Co., Inc.
Kolker Chemical Works, Inc.
John B. Moore Corp.
Solvay Process Division

### Nitrogen-Containing

**34.6.1.** The Commercial Solvents Corporation has issued Technical Data Sheet No. 23 describing the nitroparaffins—nitromethane, nitroethane, 1-nitropropane, and 2-nitropropane.

**34.6.2.** E. I. du Pont de Nemours & Co. (Inc.) has issued 12-page technical bulletin describing properties and uses of nitrocyclohexane, on excellent solvent for a wide variety of substances.

Manufacturers:
Carbide & Carbon Chemicals Company
Commercial Solvents Corp.

### Terpene

**34.7.1.** Hawkins & Armstrong present equations to express the vapor pressure-temperature relations for $\alpha$-pinene and $\beta$-pinene between 15° and their normal boiling points and these relations are recorded The normal boiling points were found to be $155.9 \pm 0.1°$ for $\alpha$-pinene and $166.0 \pm 0.1°$ for $\beta$-pinene. (JACS-65)

cf: 14.1.4
14.1.6

Manufacturers:
American Turpentine Farmers Assn.
Arizona Chemical Company
Godfrey L. Cabot, Inc.
Central Solvents & Chemicals Company
Hercules Powder Company
Newport Industries, Inc.

# OILS AND FATTY ACIDS

## CHAPTER 35

# OILS AND FATTY ACIDS

### General

**35.1.1.** The solvent segregation of oils is discussed by LeRiche and Stubbs with particular reference to the use of liquid propane in the "Solexol" process. The mechanical, physical and technical properties of drying oils so produced are detailed, and oils having improved drying, color retention and uniformity of properties produced by segregation of sunflower seed oil and fish oils are described. The segregation of soybean, tobacco seed and dehydrated castor oils are briefly discussed. (JOCCA-17)

**35.1.2.** Chirgwin proposes that on the basis of Bailey's equation for deodorization, there is an optimum sparging rate, characteristic of each individual system, for steam distillation and its specialized forms, such as deodorization and stripping. It is suggested that the principles involved are applicable to continuous or batch systems of any size.

A simple method of determining this optimum rate is described and illustrated with data from a commercial batch deodorizer.

It is proposed that, under optimum conditions:

a. the ration of absolute pressure (P) to the blowing steam rate (R) is at a minimum;
b. total distillation is at a maximum;
c. the linear velocity of the vapor is at a maximum;
d. entrainment is disproportionately high.

It is recognized that this technically optimum blowing steam rate may not coincide with the most economical conditions of operation, depending on the characteristics of the system. (JAOCS-5)

**35.1.3.** Farooq & Siddique studied the fixed oil from the seeds of *Leucaena glauca*, Benth. (N.O. Leguminosae) for its component acids. The fatty acid composition, as determined by the ester-fractination analysis was found to be

| | |
|---|---|
| Palmitic | 12.74 |
| Stearic | 5.01 |
| Behenic | 3.64 |
| Lignocerie | 0.67 |
| Oleic | 23.63 |
| Linoleic | 54.31 |

(JAOCS-11)

**35.1.4.** Narayan & Kulkarni present nomographs for calculating the fatty acid composition of oils and fats from iodine values and either extinction coefficients or thiocyanogen values.

Very few alignment charts are available which can be used for routine calculations in fat analysis and processing. Three alignment charts are presented for determining the fatty acid mixture consisting variously of linolenic, linoleic, oleic, and saturated fatty acids or glycerides, incorporating for accuracy, data based on ultra-violet extinction coefficients. In two of the charts, triangular diagrams have been used to give directly the fatty acid composition. (JAOCS-19)

**35.1.5.** Oilar reviews several rare and uncatalogued oils of Ecuador. The oils discussed are all of vegetable origin. Also mentioned briefly are some oils from Columbia, Mexico, and Barbados, B.W.I. (JAOCS-20)

**35.1.6.** Piskur presents part one of the annual review of literature on fats, oils, and soaps reported by the Literature Review Committee. Groups covered in this first part include Introduction, Production Processes, Fatty Products (Except Detergents), and Deterioration of Fats and Oils. (JAOCS-23)

**35.1.7.** Piskur presents part two of the annual review of literature on fats, oils, and soaps reported by the Literature Review Committee. Groups covered in this second part include physiology and biochemistry, characteristics and composition, and detergents. Also included is a table "Characteristics of Fats and Oils" listing approximately 40 fats and oils, and a table "Composition of the Fatty Acids" listing approximately 30 fatty acids. (JAOCS-27)

**35.1.8.** Candlenut oil can be used, at least to a substantial extent, as a replacement for linseed in paints and after heat treatment, in varnishes and linoleum manufacture. The oil has been utilized commercially in Australia as a satisfactory alternative to linseed oil. (PM-48)

**35.1.9.** Prane discusses the use of safflower oil in paint vehicles. This oil has been known and cultivated for many years throughout parts of the world; however its use as a constituent for processed oils, varnishes, alkyds, and industrial coatings is rather recent. Safflower oil contains no conjugated fatty acids, has a high percentage of linoleic acid and low linolenic acid, saturated fatty acid and saturated plus oleic content. (OD-38)

**35.1.10.** Recent work at the Paint Research Station and the University of Liverpool has indicated that conophor oil may be successfully substituted for linseed oil in the manufacture of paints and varnishes. Bray reviews the progress in experimental

cul ivation of the vine and the resul s of the examination of the oil roduced. (PM-61)

**35.1.11.** Gupta, et al, discuss the component acids of Kamala oil which shows promise as a substitute for tung oil. It contains about 60% of kamlolenic acid as the only major component with minor proportions of common linoleic, oleic, and saturated acids and probably some conjugated dihenoid acid. The saturated components consist mostly of myristic and palmitic acids. (JAOCS-28)

**35.1.12.** Buerki & Holt have designed a continuous liquid-liquid extractor and present procedures devised for the determination of total fatty acids, oxidized acids and unsaponifiable matter. These procedures give results that are in agreement with the present A.O.C.S. Methods.

Advantages of this new method are:

1. simple in design, easy to operate & clean
2. operation is automatic
3. extractions are made rapidly with out troublesome emulsions
4. greater accuracy is possible
5. the enclosed system minimizes health and fire hazards inherent in the present A.O.C.S. Methods.

(JAOCS-31)

**35.1.13.** Prane discusses the use of safflower oil in paint vehicles. Properties and uses are discussed. (POCR-18)

**35.1.14.** Singer presents part I of Chapter VIII on oils in Fundamentals of Paint, Varnish, and Lacquer Technology. The author discusses segregation or fractionation, styrenation, maleanation, color and color retention, cyclopentadiene addition, copolymerization, catalyzed oils, sulphurized oils, conjugated oils, and sorbic acid oils. (APJ-11)

**35.1.15.** Brushwell presents part I of "Polymerization of Drying Oils by Heat". This first part includes:

I. Polymerization of Simple Molecules
   - A. 1,4—Pentadiene
   - B. Sorbic Ester
   - C. Alpha—Pinine
   - D. Hexatriene
   - E. Methylcrotonate

II. Polymeration of Linoleates
   - A. Dimer formation
   - B. Rate studies

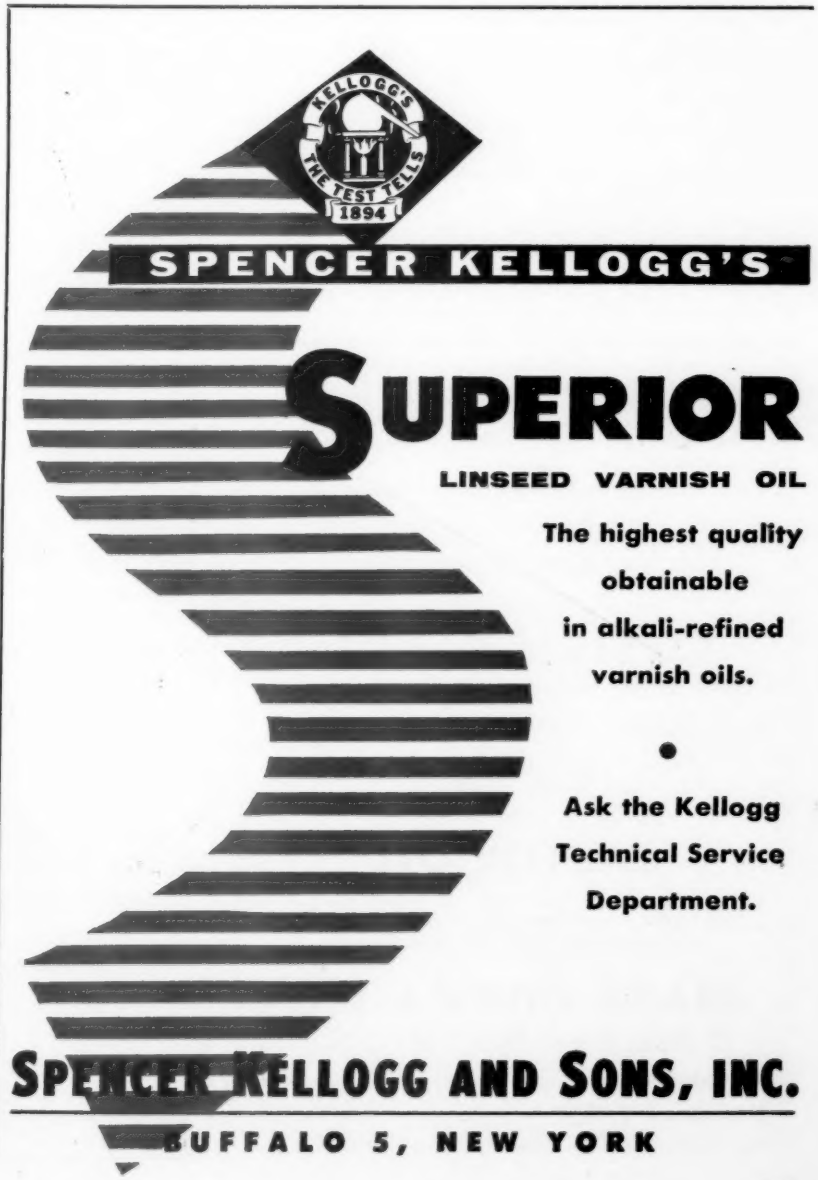
(APJ-13)

**35.1.16.** Brushwell presents Part II of "Polymerization of Drying Oils by Heat". Included are polymerization of eleostearates-monocylic dimer formation and bicylic dimer formation and cylic monomer formation, polymerization of linolenates, polymerization rates, and practical applications of thermal polymerization. (AFJ-14)

**35.1.17.** Singer presents part II of Chapter VIII on Oils in Fundamentals of Paint, Varnish, and Lacquer Technology. The author discusses tall oil and its treatment, a number of resins, and driers. (APJ-15)

**35.1.18.** Prane discusses the use of safflower oil in paint vehicles. Inherent in its composition are the following properties:

1. Uniformity of polymerization and polymer size
2. Good dry
3. Good color, color retention and freedom from yellowing
4. Decreased flexibility—due to

low content of saturated, plastizing acids.

Alkyds prepared from safflower oil exhibit:

1. Excellent through dry
2. Good gloss and gloss retention
3. Very good color and color retention
4. Improved compatibility with other film formers
5. Improved compatibility with low KB thinners—particularly odorless mineral spirits. (APJ-31)

**35.1.19.** Prane discusses the use of safflower oil in paint vehicles. Safflower oil possesses the following points:

1. high percentage of linoleic acid
2. low linolenic acid content
3. low saturated fatty acid content
4. low saturated and oleic content
5. contains no conjugated fatty acids. (PIM-11)

**35.1.20.** The Archer-Daniels-Midland Company has issued 24-page booklet listing specifications and uses of ADM oils, fatty acids, specialties, & chemical products.

cf: 13.1.4
18.1.6
36.2.6
38.1.11
50.1.1
50.3.8
50.7.1
50.9.1

Manufacturers:
Armour Chemical Division
Brown-Allen Chemicals, Inc.
El Dorado Oil Works
National Lead Company
Pacific Vegetable Oil Corp.
Spencer Kellogg & Sons, Inc.

### Linseed Oil

**35.2.1.** Fractionation techniques evolved to study the basic mechanism of thermal polymerization of drying oils can be applied to the technological evaluation of stand oils produced under different conditions. Walker, Mackay and Taylor describe two types of molecular distillation apparatus (a) a falling-film still, (b) a centrifugal cyclic still and illustrate their use in fractionating stand oils or methyl esters. Two versions of a novel liquid-liquid extractor are also shown, viz., a small-scale (100g) apparatus and a large-scale (1,000g) apparatus. The paper chromatography method used by Kaufmann in the examination of stand oils is critically reviewed. A series of stand oils of increasing viscosity have been fractionated by the above methods, and have been examined analytically and technologically. An air-blown stand oil (Bis oil) has been examined and compared with an uncatalyzed oil of similar viscosity. The importance of this work when applied to the manufacture of print paints for the linoleum industry is indicated. (JOCCA-12)

**35.2.2.** Cargill's new electronically controlled solvent extraction plant for linseed oil is now in full production in Minneapolis, Minn. The use of the Belgian DeSmet solvent process and equipment results in better refined special oils with less color. (CEN-12)

**35.2.3.** Paschke & Wheeler studied the inter- and intramolecular polymerization of heat-bodied linseed oil. Linseed oil was polymerized at 300° for 1.5, 3, and 6 hours. The polymeric glycerides were separated from the monomeric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glycerides, and the derived methyl esters of each fraction were analyzed for monomer, dimer, and trimer.

The monomeric glycerides showed very little intradimerization ranging from 1.3 to 6% of the acid groups, or 3 to 4% of the total polymeric acid groups in the whole oil.

The polymeric glycerides showed appreciable introdimerization, from 10 to 20% of their total polymeric acid groups.

There was no evidence of a shift from intra- to interdimerization being the major cause of the sudden increase in viscosity in the later stages of thermal polymerization. (JAOCS-25)

**35.2.4.** Slansky describes some experiments dealing with the alkali isomerization of linseed oil fatty acids, using glycerine as solvent, and leading to conjugation of about 50% of the total fatty acids. It was possible to separate a fraction from the isomerized linseed oil fatty acids, the triglyceride of which had a gelation time similar to that of tung oil. Despite the short gelation time the film-forming properties of this oil, with the exception of drying rate, were not very different from those of untreated linseed oil. It was found that a considerable amount of stearic acid was formed during the reaction of isomerization. This may explain the absence of parallelism between the gelation time and film-forming properties of alkali isomerized linseed oil. (PM-37)

**35.2.5.** Sims studied the dilution polymerization of linseed oil. An inert diluent, molecularly distilled mineral oil, when present in 90% concentration, permitted, in linseed oil, the polymerization of acyl groups in the absence of interglyceride reaction. Comparison of the data for the polymerization of linseed oil in 10,20, and 100% concentrations showed a marked concentration dependence for the following: polymerization of acyl groups and glyceride molecules; change in specific refraction and the ratio of percentages by weight polymeric acyl groups to polymeric glyceride molecules. (JAOCS-30)

**35.2.6.** Cargill, Inc., processors and refiners of vegetable oils, have announced their new solvent extraction plant for linseed oil is now in full production in Minneapolis. This electronically controlled plant is the first linseed plant of its kind in America. (APJ-37)

**35.2.7.** Linseed Oil: Archer-Daniels-Midland Co. has started production at its new $2-million linseed-oil plant at Buffalo, N. Y. reported to be one of the largest Buffalo waterfront developments in recent years.

cf: 35.1.1
38.1.1
38.1.11
39.1.3
50.1.1
50.1.10

Manufacturers:
Archer-Daniels-Midland Company
Brown-Allen Chemicals, Inc.
Cargill, Inc.
National Lead Company
Pacific Vegetable Oil Corp.
Spencer Kellogg & Sons, Inc.

### Castor Oils

**35.3.1.** Patton & Lindlaw discuss the use of tall oil-dehydrated castor oil blends to prepare inexpensive quality varnishes. Refined tall oil and a Z3 viscosity bodied dehydrated castor oil form the key varnish components. The paper discusses proper techniques for preparing these economical quality varnishes and reports on their performance characteristics. (PVP-20)

**35.3.2.** Bolley studied the optical activity of castor oil and its derivatives. Pure methyl ricinoleate and methyl acetyl ricinoleate were prepared. The mixed methyl esters and acetylated methyl esters of castor oil were also prepared. By the determination of specific rotation of the pure and technical esters, the percentage of ricinoleate fraction can be deduced. This was calculated to be 93% and 90%, respectively. The esters of castor oil were calculated to contain 91.6% ricinoleate from the chemical hydroxyl value. This was about the average of the two values obtained optically and is believed close to the actual value. A number of castor oils were analyzed by both optical and chemical methods and found to be of nearly constant ricinoleic content. Dehydrated castor oil was found to have a comparative high specific rotation. This was believed due to its estolide content formed during dehydration. (JAOCS-1)

**35.3.3.** Slansky discusses various methods for the dehydration of castor oil both in the laboratory and on a commercial scale. Much of the information is given in tabular form to facilitate reference. Seven tables are included covering properties of castor oils dehydrated using various catalysts, results of neutralizing experiments, preparation of large batches of DCO, influence of various drier combinations, drying properties of various oil combinations, drying time and water resistance of various varnishes, and water absorption of various varnishes. (PM-30)

**35.3.4.** Kissal, et al, studied analytical control of processes for dehydrating castor oil. As a result some spectroscopic methods were developed to supplement those chemical methods of analysis which experience has shown will give the most consistent results.

The new methods employing infrared and ultraviolet spectroscopy are compared. It was found that the degree of dimerization could be estimated from ultraviolet data. (OD-25)

**35.3.5.** Penoyer, et al, discuss the synthesis of drying oils by thermal splitting of secondary fatty acid esters of castor oil. The hydroxyl attached to the 12th carbon of ricinoleic acid in castor oil has the characteristics of a secondary alcohol function, and it can form esters with fatty acids. The formation and decomposition of the secondary esters in a process where castor oil is dehydrated in the presence of free fatty acids is the subject of this research. (JAOCS-32)

cf: 35.1.1
38.1.11

Manufacturer:
Spencer Kellogg & Sons, Inc.

### Tung Oils

**35.4.1.** Plank, et al, have developed a new modification of the Rosenmund-Kuhnhenn method for determining the total ethylenic unsaturation of tung oil and eleostearic acids. With tung oils this method results in iodine values which are in agreement with those obtained by quantitative catalytic hydrogenation and, in the case of $\alpha$- and $\beta$-eleostearic acids, with the theoretical value. Good agree-

ment was found with hydrogen-iodine values of various partially hydrogenated tung oils. Mercuric acetate is added to the oil prior to the addition of the R-K reagent in contrast to the Benham-Klee modification where the reagent is added first. Light was found to affect the results obtained. (JAOCS-3)

**35.4.2.** Planck presents a review of tung oil for 1951-1952. 205 references are cited. (JAOCS-6)

**35.4.3.** Planck, et al, have applied recently developed spectrophotometric methods for the determination of linoleic and conjugated dienoic acids in the presence of large amounts of eleostearic acid to the determination of the fatty acid composition of a series of progressively hydrogenated tung oils. Utilizing hydrogen-iodine values and independently obtained values for saturated fatty acids, it has become possible to calculate concentrations of isolinoleic and of monoethenoic acids. Use of these methods gives a more complete and accurate knowledge of the fatty acid composition of a partially hydrogenated tung oil, or mixture of other oils containing the same types of components, than has been obtainable by previously published spectrophotometric methods. They are also much less time-consuming than solvent fractionation methods.

Data are presented which show the changes in fatty acid composition occurring during the hydrogenation of a domestic tung oil from an iodine value of 231 to 78. (JAOCS-8)

**35.4.4.** Holmes & Pack investigated the storage of tung oil in clean, well-filled gallon containers for more than three years and at the end of that time the oil still met A.S.T.M. specifications.

Storage locale (indoor, outdoor, sheltered, or unsheltered containers) and the exterior coating on the containers in exposed locations were found to be of less importance than protection of the stored oil from atmospheric oxygen.

The most pronounced effect of prolonged storage on tung oil is a shortening of the heat test (gel time at 282° C.)

Uncontaminated tung oil does not spontaneously isomerize during storage. (JAOCS-16)

**35.4.5.** McKinney & Holmes present a rapid petroleum naphtha method for determining the oil content of tung products. The method was applied to samples of tung fruit, press cake, and filter cake. Portions of these samples were also analyzed for oil content, using the Official Methods of the American Oil Chemists' Society for Tung Fruit and Meal. This new rapid method gave results which were in good agreement with those obtained with the 4-hr. extraction with petroleum ether required in A.O.C.S. Official Method Ad 3-52. (JAOCS-22)

Manufacturers:
Brown-Allen Chemicals, Inc.
Pacific Vegetable Oil Corp.

### Soybean Oil

**35.5.1.** Arnold and P'Pool have secured data on the countercurrent extraction of soybean flakes by trichloroethylene in a laboratory extraction pilot plant having a capacity of about 10 lbs. per hour. Feed rates and extraction times departed only slightly from a straight line relationship with the speed of the chain used to move the flakes through the extractor. Over the ranges studied, changes in solvent-feed ratios had a much greater effect than the extraction time on the amount of oil extracted. Over a practical range of temperatures with the solvent-feed ratio constant, the residual oil content of the meal showed a straight line relationship with the temperature. (JAOCS-9)

**35.5.2.** Dunning & Terstage describe the prepressing of soybeans prior to solvent extraction. Soybeans readily lend themselves to the pre-pressing operation. The pre-pressed, conditioned, and flaked soybean cakes however even at less than 10% oil content do not show a higher rate of extraction over standard soybean flakes. (JAOCS-13)

**35.5.3.** Carrick & Trease investigated the cohesive strengths of alkali refined soybean oil films to determine the effect of the addition of pigments. Pigments used were ppt. $CaCO_3$, anatase $TiO_2$ and carbon black with 3 particle size ranges for each. The results of these tests have shown that pigments exert a definite reinforcement effect on the cohesive strength of a paint film. (POC R-27)

cf: 35.1.1
Manufacturers:
Archer-Daniels-Midland Company
Brown-Allen Chemicals, Inc.
Cargill, Inc.
Pacific Vegetable Oil Corp.
Spencer Kellogg & Sons, Inc.

### Oticica Oil

**35.6** (No Abstracts)

Manufacturers:
Pacific Vegetable Oil Corp.

### Fish Oil

**35.7.1.** The Archer-Daniels-Midland Company has issued 18-page Technical Bulletin 904A describing ADM Sperm Oil products; characteristics, chemical and physical properties, composition, applications and suggested uses for sperm oils, fatty acids, and sperm-aceti wax.

cf: 35.1.1
35.10.3
Manufacturers:
Archer-Daniels-Midland Company
Cargill, Inc.
Pacific Vegetable Oil Corp.

### Tall Oil

**35.8.1.** Karabinos & Ballum continue their tall oil studies. A method for decolorizing tall oil-ethylene oxide condensates (polyethenoxy tallates) by use of ozone or hydrogen peroxide is presented. The chemistry of the possible reactions involving quinoid structures is discussed. (JAOCS-15)

**35.8.2.** Ferlin, et al, report on the bactericidal activity of polyethenoxy tallate ozonides. It was assumed that the fat-soluble, water-soluble ozonides were responsible for this germicidal activity. However it was found that decomposing the ozonides to their corresponding acids (e.g., by hydrogen peroxide in aqueous acetic acid) not only increased bactericidal activity but that the active principle could be separated from the residual polyethenoxy esters by steam distillation. It was determined that the active bactericidal principle was essentially pelargonic acid and that the activity varied with the pH of its solution. (JAOCS-17)

**35.8.3.** Karabinos & Ballun continuing their tall oil studies discuss the synthesis and comparative detergency of built polyethenoxy sitosterols. (JAOCS-18)

**35.8.4.** Twice-blessed, tall oil and its components have an abundant

source and a market waiting. Cheaper refining methods will build a better bridge between the two. (C -19)

**35.8.5.** Brushwell discusses economics and chemistry of tall oil. Tall oil is now an accepted and important raw material for the paint industry. The history of tall oil, the statistics related to its production, the chemistry of this interesting product, and the refining and manufacturing techniques applied to it are described in detail. (APJ-69)

**35.8.6.** Brushwell presents part II in his series on tall oil and its functions in the paint industry. This part discusses the properties of commercial tall oil products. Typical properties of a polymerized tall oil and a solvent-extracted oil are presented. Included are the manufacture and refining of tall oil, fractionation of tall oil, chemical modifications of tall oil, analytical methods applied to tall oil, and the handling of tall oil. (APJ-74)

**35.8.7.** In a process for treating tall oil, the steps of fractionally distilling tall oil, withdrawing an overhead fraction consisting mainly of low-boiling unsaponifiable matter and palmitic acid, taking off a second fraction consisting mainly of oleic acid and linoleic acid and fractionally crystallizing the second fraction to obtain oleic acid in the solid phase. (USP-67)

**35.8.8.** The Tall Oil Association has issued Bulletin No. 13 presenting Part I of "Tall Oil for Resins".

**35.8.9.** The Tall Oil Association has issued Bulletin No. 14 presenting Part II of "Tall Oil for Resins".

cf: 14.1.2
35.1.1
35.1.17
35.3.1
36.5.6
38.1.11
39.2.8

Manufacturers:
Arizona Chemical Company
Newport Industries, Inc.
K. A. Steel Chemicals, Inc.
Union Bag & Paper Corp.

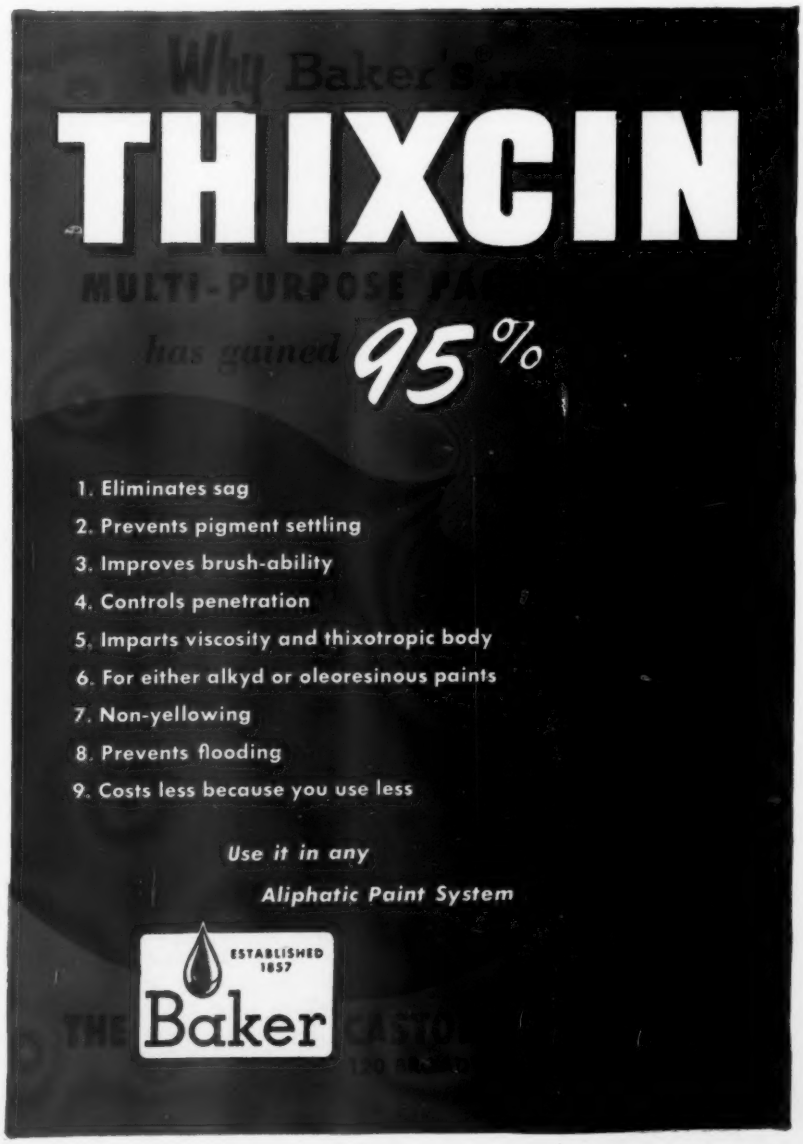
### Synthetic Drying Oils

**35.9.1.** Weiss describes the properties of modified oils obtained from saturated fatty acids. The process involves the addition of an organic 'catalyst" to solutions of saturated fatty acids. The solutions thicken, their acid values fall, and when spread in thin films the resulting oil is sensitive to oxygen and dries to give a protective film. (PM-22)

**35.9.2.** Gourley discusses pentaerythritol drying oils as paint media. The change from glycerol to pentaerythritol esters in fatty oils for paint media leads not only to faster polymerization and harder films but also to better outside durability, according to the results of experiments described in this article. The oil obtained by esterifying linseed oil fatty acids with pentaerythritol has been tested against linseed oil in orthodox oleoresinous white paints based on nine commercially available hard resins. (PM-43)

**35.9.3.** Terrill discusses improved drying oils. One phase of the many advances in coating chemistry and technology in recent years has been the development of various modified drying oils. Factors involved in this development have been

1. war-induced shortage of natural drying oils
2. over-all expanding market
3. need for better coatings
4. desirability for utilization and

development of domestic sources of drying oils, and for interchangeability among various oils

5. general advance of research and of applied chemistry. (PIM-3)

**35.9.4.** A process for improving the air-drying properties of a liquid co-polymer resulting from the co-polymerization of an aliphatic mono-isoolefin hydrocarbons and a conjugated diolefin hydrocarbon each containing not more than about 8 carbon atoms per molecule, in the presence of hydrogen fluoride catalyst at a temperature of from about—100° to about 0° C., whereby the copolymer contains organic fluorides, said process comprising separating said liquid co-polymer from the hydrogen fluoride catalyst and thereafter commingling therewith a polyhydric alcohol in the ratio of from about 1 to 1 to about 100 to 1 weight proportions of co-polymer to polyhydric alcohol, and subjecting the resultant mixture to reaction at a temperature of from about 50° to about 250°C. to effect substantial condensation of the hydroxyl groups of said alcohol with the organic fluorides in the co-polymer.

The process of claim 1 further characterized in that said co-polymer and polyhydric alcohol are reacted with a carboxylic acid. (USP-9)

**35.9.5.** A process for preparing a drying oil which comprises mixing a cyclopentadiene with an acylated linear copolymer of about 10 to 30% styrene and 90 to 70% isobutylene having a molecular weight between about 1,000 and 20,000 and containing about 0.2 to 1 mole of combined acyl groups per mole of aromatic styrene nuclei of the copolymer chain, about 0.5 to 1.2 moles of the cyclopentadiene being present in the reaction mixture per mole of combined acyl groups and maintaining the mixture at 10° to 50° C., in the presence of a metal alcoholate condensing agent until the cyclopentadiene and the carbonyl groups of the acylated copolymer are condensed with the elimination of water. (USP-26)

**35.9.6.** An enamel base comprising an oily sodium copolymer of 75 to 85 parts of butadiene-1,3, 25 to 15 parts of styrene and 0.05 to 0.5 part of maleic anhydride combined therewith, said copolymer having an intrinsic viscosity between about 0.15 and 0.30. (USP-32)

**35.9.7.** A process for producing a drying oil composition, which comprises admixing a polymer consisting essentially of an unsaturated, pre-dominantly open-chain liquid hydrocarbon polymer of an open chain conjugated diolefin, said polymer having a viscosity of from 20 to 150 poises at 77° F., with an unsaturated glyceride oil in the amount of 2 to 20 per cent by weight of said glyceride oil, and heating a resulting admixture at 550 to 600° F. for 2 to 6 hours. (USP-37)

**35.9.8.** A process for preparing a drying oil which comprises co-polymerizing a mixture of from 75 to 85% of butadiene and 25 to 15% of styrene in 200 to 300 parts of a hydrocarbon diluent per 100 parts of monomers and 20 to 30 parts of a member of the group consisting of aliphatic ethers of 4 to 8 carbon atoms and cyclic diethers of 4 to 8 carbon atoms, in the presence of 0.5 to 5 parts of finely divided sodium at a temperature between 40 and 85° C., continuing the polymerization until substantially 100% conversion is obtained where a product is obtained which has a viscosity somewhat less than that ultimately desired, killing and removing the catalyst and then heating the product in the absence of air at a temperature between 175 and 275°C. until a drying oil having the desired viscosity is obtained. (USP-102)

**35.9.9.** A process for improving a polymeric drying oil prepared by copolymerization of 75 to 85 parts of butadiene-1,3 and 25 to 15 parts of styrene in the presence of metallic sodium which comprises mixing said oil with 0.5 to 10% of a reagent selected from the group consisting of acrylic nitriles, alkyl acrylates, vinyl acetate, vinyl ketones, cinnamaldehyde, thioglycolic acid, alkylthioglycolates, and thiosalicyclic acid, and heating the mixture at a temperature between 50° and 250° C. (USP-150)

**35.9.10.** The Enjay Company, Inc. has issued Technical Bulletins No. 2 and No. 3 describing C-6 oil, a hydrocarbon drying oil, and the preparation of resins from C-6 oil.

Manufacturers:
Enjay Company, Inc.
McClosky Varnish Company
Pan American Chemicals
Reichhold Chemicals, Inc.
Fred'k A. Stresen-Reuter, Inc.

### Fatty Acids

**35.10.1.** Earhart reviews trends and factors affecting the use of fatty acids in alkyd resins. The major variables have been divided into the following categories — trends in the uses of alkyds, trends in the formulation of alkyds, economic trends, trends in the use of fatty acids, trends in fatty acids availability, and trends in specifications. (PVP-30)

**35.10.2.** Knight, et al, describe a new method for hydroxylating long-chain unsaturated compounds which involves addition of formic acid at its boiling point to the double bond followed by hydrolysis of the intermediate formate esters. The addition reaction proceeds slowly in absence of catalysts but strongly acidic substances, such as perchloric or sulfuric acids, speed up the addition tremendously.

Monohydroxystearic acids can be prepared in good yield by addition of 90-100% formic acid to the double bond of oleic or elaidic acids, methyl oleate, followed by hydrolysis.

Acetic acid in the presence of acidic catalysts also adds to the double bond at its boiling point, but yields are lower than with formic acid. (JAOCS-10)

**35.10.3.** Abu-Nasr, et al, studied the fractionation of highly unsaturated fatty acids by urea inclusion compounds. Urea segregation has been found to be a useful tool in concentration of highly unsaturated acids and esters. Fatty acids and esters derived from fish oils and methyl esters of hog adrenal fatty acids have been fractionated and the polyunsaturated acids have been enriched. The tendency for fatty acids and esters to combine with urea decreases with increasing unsaturation. Combination is favored by lowered temperature. (JAOCS-12)

**35.10.4.** Karabinos & Ferlin determined the bactericidal activity of certain fatty acids. Fatty

acids in the $C_8$ to $C_{12}$ range are bactericidal to a number of different organisms, and this activity is markedly enhanced with increasing acidity. Optimum bactericidal activity to *Staphylococcus aureus* was exhibited by undercylic acid. Since the activity is of the order as that of the quaternary ammonium germicides in alkaline solution, an explanation for both types of germicidal activity is presented in which the bacteria or some protein essential to the bacteria are considered to be "suffocated" by a "coating" of fatty groups in chemical combination with the protein. (JAOCS-26)

**35.10.5.** Earhart discusses trends and factors affecting fatty acid usage in alkyd resins. The major variables have been divided into the following categories:

1. Trends in the uses of alkyds
2. Trends in the formulation of alkyds
3. Economic trends affecting the use of fatty acids in alkyds
4. Trends in the use of fatty acids that may be affected by other chemicals for resins
5. Trends in fatty acids available for resin manufacture
6. Trends in specifications for fatty acids. (APJ-33)

**35.10.6.** The Archer-Daniels-Midland Company has issued 40-page booklet describing uses and properties of Hydrofol Products. These include sperm oils, hydrofol fatty acids, adol fatty alcohols, hydrofol glycerides from vegetable, animal, and marine oils and fats.

**35.10.7.** The Polychemicals Department of E. I. du Pont de Nemours & Co. (Inc.) has issued four technical data sheets describing properties and uses of Loral 5,7,20,22,24 and 28, a series of fatty alcohols.

**35.10.8.** Emery Industries, Inc. has issued 9-page Technical Bulletin No. 50-A describing properties, characteristics, solubility data, and applications of some new Emery modified solid acids.

**35.10.9.** Emery Industries, Inc. has issued Technical Bulletin #53 properties of Emfac 1202 Pelargonic acid, a fully saturated C-monobasic fatty acid, and its use in baking enamels.

cf: 16.1.2
16.1.3
35.1.4
35.1.20
50.1.4

Manufacturers:
Archer-Daniels-Midland Company
Arizona Chemical Company
Armour Chemical Division
El Dorado Oil Works
Emery Industries, Inc.
A. Gross & Company
Pacific Vegetable Oil Corp.
Spencer Kellogg & Sons, Inc.
Swift & Company

### Fatty Alcohols

**35.11.1.** The Archer-Daniels-Midland Company has issued 10-page Technical Bulletin 903A Describing properties and uses of ADM Fatty Alcohols—Adols and Unadols.

**35.11.2.** The Ethyl Corporation has issued 8-page Chemical Sales Bulletin describing Fatty Alcohols for Industry.

cf: 35.10.6
Manufacturers:
Archer-Daniels-Midland Company
E. I. duPont de Nemours & Co., Inc.
Ethyl Corporation
The Stephan Chemical Company

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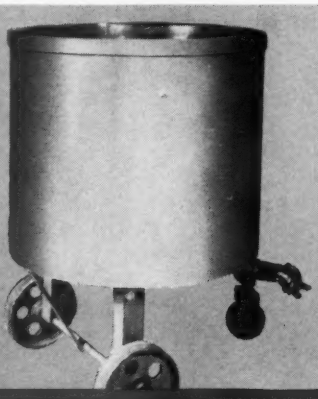

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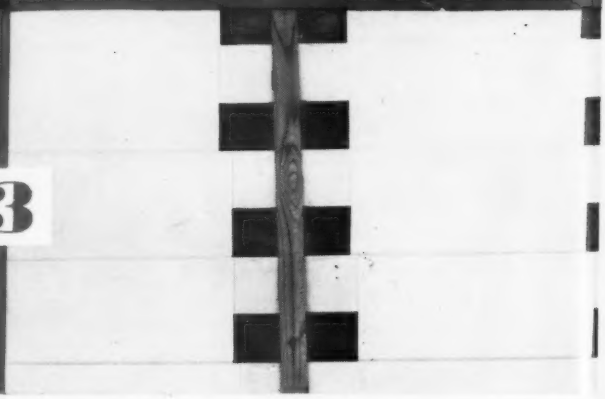

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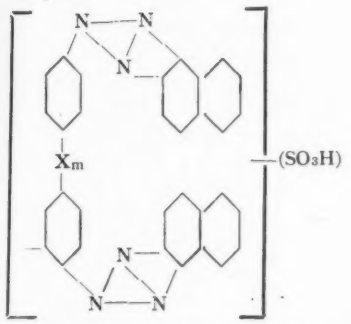
## CHAPTER 36

# MISCELLANEOUS RAW MATERIALS

### General

**36.1.1.** Brandt & Nunn discuss the use of ultraviolet light absorbers in clear furniture lacquers. Of the materials tested, two materials, both substituted benzophenones, proved to be effective absorbers of ultraviolet radiations without being destroyed by such radiations. Their use in furniture lacquers did not interfere with the normal bleaching effect that sunlight has on white oak and black walnut. (PVP-49)

**36.1.2.** A compound of the group consisting of acids of the general formula:




wherein X stands for a vinylene and *m* for a whole number form 0 to 1, and salts of such acids selected from the group consisting of the alkali metal, ammonium, alkaline earth and amine salts, said compounds being substantially colorless and possessing an excellent whitening effect.

White organic materials having incorporated therein an effective amount of a whitening agent as defined in claim 1. (USP-86)

**36.1.3.** The Advance Solvents & Chemical Corp. has issued a loose leaf binder containing a complete set of bulletins describing the Advance Driers and Paint Specailties, Paint Additives, Plasticizers, and Stabilizers.

### Driers

**36.2.1.** Mueller proposes a mechanism of drier action in drying oil oxidation and polymerization. Lundberg, et al, present a panel discussion of the proposed mechanism. (IEC-44)

**36.2.2.** Skoog & Focht developed a very simple and rapid procedure for the analysis of lead driers which does not require the preliminary isolation of the metallic ion from the organic substrate. Various lead naphthenates, octoates, linoresinates, linoleate and resinate were investigated. The naphthenates of several other metals were also investigated to determine whether this technique might not have wider application. These included iron, cobalt, manganese, copper, and zinc naphthenates. Only copper gave a satisfactory wave; further work on copper soaps is now in progress and results to be published subsequently. (AC-2)

**36.2.3.** Stearns discusses the use of 1,10-phenanthroline to promote the drying of paints. 1,10-phenathroline accelerates, in varying degree, the drying of all films which cure by polymerization, or by oxidative-polymerization. The drying rate is stabilized by the presence of 1,10-phenanthroline.

An optimum point can be found for each combination of drier metal and 1,10-phenanthroline where drying is most rapid; stabilization appears to be most assured at this optimum point. (OD-61)

**36.2.4.** Rinse discusses aluminum alkoxides as new components in the preparation of vehicles for paints. In the presence of humid air, aluminum alkoxides act as driers and permit the preparation of tall oil paints which dry in a matter of seconds on exposure to humid air. (PT-1)

**36.2.5.** Gregg discusses the use of zirconium metal as a drier catalyst. Zirconium acts as a drier product capable of synergism. Its utilization in combination with cobalt, manganese, calcium, is of great interest to the paint finish formulator. (PIM-14)

**36.2.6.** A process of treating a drying glyceride oil which comprises heating the oil to bodying temperature in the presence of .05 to 3% of a catalyst consisting essentially of 9-anthrone until a desired increase of viscosity is attained. (USP-96)

**36.2.7.** The Advance Solvents & Chemical Corp. has issued 66-page Handbook of Driers and Specialty Chemicals for the Paint, Varnish and Lacquer Industries.

**36.2.8.** The Harshaw Chemical Company has issued 2-page bulletin describing properties of Lo-Odor Octasol Driers—Harshaw 2-Ethylhexoates.

**36.2.9.** R. T. Vanderbilt Co., Inc. has issued 4-page bulletin describing the use of Activ-8 in a Tall Oil Alkyd Vehicle.

**36.2.10.** The Witco Chemical Company has issued Bulletins P-20 and P-21 describing Witco Odorless Cobalt and Lead Driers. Drying power of each is equivalent to the corresponding naphthenate.

**36.2.11.** The Witco Chemical Company has issued Bulletin 54-2 describing Witco Driers—Their Properties and Uses.

cf: 4.1.2
35.1.17
36.4.5

39.1.3
50.3.1

Manufacturers:
Advance Solvents & Chemical Corp.
The Harshaw Chemical Company
McClosky Varnish Company
Naftone, Inc.
Nuodex Products Company, Inc.
Fred'k A. Stresen-Reuter, Inc.
R. T. Vanderbilt Company, Inc.
Witco Chemical Company

**Fungicides**

**36.3.1.** Meier & Schmidt review the growth of fungi on paint films. Destruction of paint films is due not only to the action of moisture, heat, cold, sunrays and mechanical influences, but in a much higher degree to the growth of fungi.

The authors discuss the kinds of fungi, conditions of growth (food, temperature, moisture and light), behavior of vehicles, influence of pigments, properties of paint films attacked by fungi growth, and protection against fungi growth. (PVP-26)

**36.3.2.** Brown, et al, studied the mildew—preventing activity of rhodanine derivatives. Certain of these derivatives have been found effective in preventing rot of cotton cloth and the effect of variation in structure on the activity of some related derivatives has been studied.

The most active compounds in the series were 5-(p-chlorobenzylidine) rhodanine and 5-(2-thenylidene) rhodanine. Cotton strips impregnated with 1% concentration of the above substances lost not more than 15% of their tensile strength after burial in composted greenhouse soil for 4 weeks. The 5-substituted 2,4-dioxothiazolidines, while less effective than the corresponding 5-substituted rhodanines, in general, followed the same order of activity. (IEC-65)

**36.3.3.** Beaver, et al, describe the preparation of 17 new trisphenols by three procedures. Their physical properties and bacteriostatic activity against two types of bacteria and one fungus are shown. (JACS-10)

**36.3.4.** Nine 5-(1-methyl-2-thioalklethylidene)-rhodanines have been synthesized by condensation of rhodanines with alkyl acetonyl sulfides. Of the sulfides required for this work, by Brodsher, et al, seven are here reported for the first time. The fungistatic action of the new rhodanine compounds has been compared with that of the 5-(1-alkylethylidene)-rhodanines. (JACS-24)

**36.3.5.** Grupp reports on tests made by the Naval Research Laboratory on fungicide attenuation by oils. Some progress has been made but it is far from being satisfactory. Tests made at NRL indicate that the toxic non-pigmented finishes presently being made are of doubtful value. Salicylanilide seems to be better than most compounds as a fungicide when added to an organic protective coating. But on the whole there are no good fungicides for such application. Many compounds that are exceedingly toxic in vitro chemical tests are amazingly innocuous when added to protective coatings. (OF-31)

**36.3.6.** Bradsher, et al, have confirmed the reported toxicity of 2- and 3-phenanthrol toward *Aspergillus niger* and the toxicity has been shown to be general for some fluorenols and hydroxybiphenyls. Introduction of an alkyl group into the 4-, 6-, or 4'-position of 3-hydroxybiphenyl failed to enhance its fungistatic activity. (JACS-49)

**36.3.7.** In an investigation of phenylmecuric fungicides, it became desirable to determine why some formulations appeared to give better results than others. One possible explanation was that diphenylmercury, a relatively inactive material against the fungus under investigation, might be formed. Miller & Polley, describe procedures making possible the analysis of diphenylmercury, alone or in the presence of phenylmercuric compounds. A procedure is also given for the estimation of diethylmercury alone or in the presence of ethylmercuric compounds. (AC-18)

**36.3.8.** Buckman Labs., Inc. has issued 18-page Bulletin 4 PAM—Microorganism Control in the Paint Industry. Butrol properties and ease of use and handling are discussed followed by discussion of microorganism control in oil-base paints and in emulsion paints.

**36.3.9.** The Heyden Chemical Corporation has issued 16-page booklet describing Parasepts—Esters of Parahydroxybenzoic Acid—Versatile Preservatives.

**36.3.10.** The Naphthenate Preservatives Institute, Inc. has issued 24-page report on the Effectiveness of Copper Naphthenate as a Wood Preservative.

**36.3.11.** The Scientific Oil Compounding Company, Inc. has issued 3-page technical bulletin describing Cunimene D-2747, a new preservative for emulsion paints.

**36.3.12.** The Scientific Oil Compounding Company, Inc. has issued 4-page technical bulletin describing the preservation of glues and adhesives.

**36.3.13.** Scientific Oil Compounding Co., Inc. is now selling Cunimene D-2747, a Rosin Amine D. pentachlorophenate-containing (50%) fungicide and preservative for emulsion paints.

**36.3.14.** A new antifungal agent has been discovered by chemists of Sterling-Winthrop Research Institute, It's DL-threo-2-dichloroacetamido-1-(4methylsulfonylphenyl)-1,3-propenediol, shows significant activity against several species of fungi.

**36.3.15.** The order of antimicrobial activity of a group of common synthetic antifungal agents has recently been put on record by a research team at Osaka University, Japan. Compared for potency against bacteria, fungi and yeasts, five materials generally line up like this: (1) 8-hydroxyquinoline; (2) sodium pentachlorophenate; (3) 2-methyl-1,4-naphthoquinone; (4) butyl p-hydroxybenzoate; (5) dehydroacetic acid. The Japanese found that all but 8-hydrozquinoline and 2-methyl-1,4-naphthoquinone increased in effectiveness with increasingly acidic media. The former loses potency with mounting acidity; the latter is unaffected.

cf: 14.1.2
35.8.2
39.14.4
50.1.18

Manufacturers:
Advance Solvents & Chemical Corp.
Buckman Laboratories, Inc.
Carolina Aniline & Extract Company
Darworth, Inc.
The Dow Chemical Company
E. I. duPont de Nemours & Co., Inc
Ferro Chemical Corp.
The Harshaw Chemical Company
Heyden Chemical Corp.
Innis, Speiden & Co., Inc.
The McGean Chemical Company
Mallinckrodt Chemical Works
Monsanto Chemical Company
Mooney Chemicals, Inc.
Naftone, Inc.
Nuodex Products Co., Inc.
The Richfield Oil Corp.
Scientific Oil Compounding Co., Inc
The Shepherd Chemical Company
Fred'k A. Stresen-Reuter, Inc.
Triangle Chemical Company

R. T. Vanderbilt Co., Inc.
Witco Chemical Company

### Metallic Soaps

**36.4.1.** Licata discusses the function of fatty acids in metallic soaps. Such soaps are compounds of metals and fatty acids, which are characterized by water repellency, solubility in some organic liquids, extremely small particle size, and purity of the metal content. It is concluded that the fatty acid does play an important function in determining the method of preparation, the physical properties, and ultimately the use of metallic soaps. (JAOCS-24)

**36.4.2.** The use of metallic soaps as catalysts in the study of autoxidation and polymerization has led to a number of theories on the mechanism of these catalytic reactions. Skellon reviews the recent work in this field. The methods used to prepare pure soaps are outlined and reference made to the failure to obtain pure chemical compounds in some cases and to the suggested formation of physical complexes. The more important properties of these compounds, their solubility in various solvents and the wide variation in reported melting-points is also discussed. (PM-56)

**36.4.3.** The function and efficiency of a metallic soap depends in major degree on the nature and purity of the organic or anionic radical and also on the exact form of its combination with the metal. Information on these points has tended to be vague and inadequate. Morley-Smith reviews some of those properties of the more important metal soaps which are most affected by either selection of raw materials or by manufacturing technique, and to do so with special reference to those employed in paint formulation. (PM-57)

**36.4.4.** Alexander reviews synthetic and analytical data on the structure of aluminum compounds with fatty acids. There is no evidence for the existence of mono- and tri-soaps, but $Al(OR)L_2$ and $Al(OH)L_2$ can both be prepared. The structure of aluminum soaps and some account of their physical properties in solution are given. (OCCA-36)

**36.4.5.** Stewart presents the results of a study to compare the metals as drying catalysts to determine their merits as compared to the metals in common use today. Thirty-five metals were included in these tests. The vehicles were a white interior air-dry alkyd enamel, a gloss white baking enamel, a white exterior oil paint, and a white interior oleoresinous enamel. More will be added and so contribute additional useful information. The ultimate purpose of this work is to completely evaluate the metal soaps for all film properties and possible specialty uses. (OD-43)

**36.4.6.** Stumpf presents a comparison of free fatty acid content and melting point determination of metallic stearates. The melting points of most of the metallic stearates, as reported by various investigators have been observed to vary widely. The purpose of the work was to correlate the variance in melting points with the content of free fatty acids found in the soap. It is concluded that:

1. There is a relationship between free fatty acid control and melting point.
2. The grade of acid used greatly affects melting point.
3. A higher melting point acid will produce a metallic stearate with higher softening and melting point range than an acid with lower melting point and lower purity of stearic acid.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4. Variance in melting points reported may be attributed to the free fatty acid content in the soap and the melting point of the acid used.
5. The softening and melting points of any metallic stearate varies inversely with the free fatty acid content of the metallic soap. (APJ-18)

**36.4.7.** Cheremisinoff & Stumpf studied the metallic salts of sebacic acid to extend the scant information on these salts and to determine gelling (if any), physical and other properties, and be able to compare them with properties of monobasic metallic salts of fatty acids. Salts of adipic and azelaic acid were not studied as their solubilities and other properties did not markedly differ from sebacic.

Metal salts of dibasic acids have extremely high metal content and exhibit high softening and melting points. The metal sebacates are insoluble in organic solvents, though the aluminum salt indicates some compatibility with organic solvents by a slight swelling.

The sodium, potassium and lithium salts are the only ones soluble in water.

These salts from a practical standpoint of solution (except for aluminum) may be considered inert (APJ-23)

**36.4.8.** Mallinckrodt Chemical Works has issued data sheets X-234, X-251, & X-248 describing aluminum stearates technical D, T, & M.

**36.4.9.** Mallinckrodt Chemical Works has issued data sheets X-243 describing calcium stearate —technical, bulky, grade A, and impalpable, powder, grade A.

**36.4.10.** Mallinckrodt Chemical Works has issued data sheet X-239 describing zinc stearate USP XIV Grade S.

**36.4.11.** The Witco Chemical Company has issued Bulletin G-5 describing Witco gelling agents (sodium stearate and aluminum stearate) for polyvinyl chloride compositions.

cf: 36.9.1
Manufacturers:
Advance Solvents & Chemical Corp.
American Cyanamid Company
The Harshaw Chemical Company
Mallickrodt Chemical Works
Metasap Chemical Company
M. W. Parsons-Plymouth, Inc.
Fred'k A. Stresen-Reuter, Inc.
Witco Chemical Company

**Surface Active Agents**

**36.5.1.** Mankowich discusses properties of surfactants. Six interrelated physicochemical factors of the detergency process were studied. These factors—surface tension, interfacial tension, contact angle, spreading coefficient, adhesion tension, and work of adhesion have been proposed as indexes of wetting and/or emulsification. (IEC-32)

**36.5.2.** Rainey & Denoon review a number of nonionic surface active agents. New sources of base materials and a variety of specialty applications—in cleaners, stabilizers, fertilizers, and therapeutic agents—point to a growing market for nonionic surface-active agents. (CEN-3)

**36.5.3.** Denning & Daniel discuss the effect of surface active agents on pigment-vehicle systems. Flow Point determinations with three vehicles, six pigments and five surface active agents show that dispersability does not depend on either the pigment alone, or the vehicle alone, or on the surface active agent alone. It depends on the combination of all three components. Therefore, it is futile to expect any single agent to be effective in all pigment-vehicle systems. The best that can be hoped for, is to find a compromise addition agent beneficial

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**Sodium**—viscosity stabilizer for latex-base paints
**Zinc**—sanding sealer for varnishes and lacquers

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**Naphthenic**—lead, cobalt, calcium, manganese, zinc, iron
**Octoic**—lead, cobalt, zinc, calcium
**Witall® (Tallate)**—lead, cobalt, manganese, iron

**PIGMENT CARBON BLACKS**

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***Witcoblak No. 32**—maximum jetness in a low cost channel black
***Witcoblak No. 100**—medium color black, next jetter grade to No. 32
**Witcoblak Hitone**—intense jetness at medium cost
***Witcoblak F-1**—high tinting strength in a low cost, blue tone furnace black
***Witcoblak F-2**—a jetter, higher tinting strength, blue tone furnace black
***Witcoblak F-3**—very jet, high tinting strength, with very desirable blue tone

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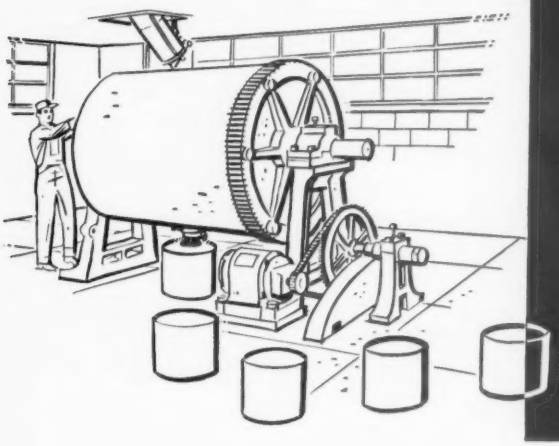

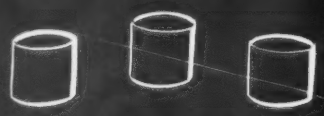

Harshaw's precise manufacturing specifications demand the following tests for every batch of driers produced:

- **Metal content**
- **Specific gravity**
- **Color**
- **Viscosity**
- **Total solids content**
- **Flash point (TCC)**
- **Moisture content**
- **Acid value**
- **Miscibility with raw linseed oil**
- **Miscibility with mineral spirits**
- **Benzene insoluble content**
- **Customer's specified tests**

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- Linoresinate Liquids
- Linoleate Liquids
- Lithos
- Octasols
- Pastes
- Pastalls

**SOLID DRIERS**

- Uversol (Naphthenate) Solids
- Linoresinate Solids
- Linoleate Solids
- Soyate Solids
- Fused Resinates

**POWDERED DRIERS**

- Precipitated Resinates
- Drying Salts:
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  - Lead
  - Manganese
  - Zinc

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in a large percentage of pigment-vehicle combinations and innocuous in the remaining cases. A large group of SAA's must be tested to find the agent producing maximum dispersing efficacy in a given pigment-vehicle system. The Flow Point method is a convenient tool for finding the best agent. (OD-23)

**36.5.4.** Bramston-Cook and Elwell review the alkylbenzenes. The utility of alkylbenzene sulfonates for surface active applications is dependent in large part on the nature of the alkyl group used. (IEC-81)

**36.5.5.** Jelinek & Mayhew review the nonionic detergents composed of nonionic surfactants. Desirable improvements of nonionics include the development of a nonionic detergent formulation of higher foam stability, and the development of a solid nonionic possessing more efficient surface active properties. (IEC-82)

**36.5.6.** Kapella, et al, discuss a study on the detergency evaluation of some nonionic derivatives of tall oil. The study involves the preparation of derivatives such as the chloro-, bromo-, hydroxy-formoxy-, etc., of the hydrophobic unsaturated and various urethanes and esters of the hydrophilic hydroxyl group. Detergency values of all of the derivatives synthesized from the polyethenoxy tallate were determined on built mixtures. (JAOCS-33)

**36.5.7.** The American Cyanamid Company has issued a 44-page booklet describing properties and uses of the "Aerosol" Surface Active Agents.

**36.5.8.** The Armour Chemical Division has issued 21-page booklet describing Ethofats, Ethomids and Ethomeens—unique cationic and non-ionic surface active chemicals.

**36.5.9.** The Atlas Powder Company has developed the "HLB Surfactant Selector". This circular slide-chart is a time-saving, easy way to choose surfactants—by matching the HLB (Hydrophile-Lipophile Balance) numbers of Atlas surfactants with the HLB numbers most desirable in the end product.

**36.5.10.** The Geigy Chemical Corporation has issued four technical bulletins describing the Sarkosyls, their anti-corrosion properties, Sarkosyl NL-30 and Sarkosyl NL-100, surface active agents.

**36.5.11.** The Geigy Chemical Corporation has issued 2-page technical bulletin describing Alrosol B, a liquid nonionic diethanolamine-fatty acid condensate.

**36.5.12.** The Glyco Products Company, Inc. has issued 24-page booklet describing Esters by Glyco, surface active agents, emulsifying agents, wetting agents.

**36.5.13.** The National Aniline Division, has issued 4-page Technical Bulletin No. 326 describing Physical and Chemical Properties and Suggested Uses for Nacconal SL, an anionic surface active agent.

**36.5.14.** The Nopco Chemical Company has issued 11-page Technical Service Data Bulletin Misc 20A describing Nopco wetting agents.

**36.5.15.** The Oronite Chemical Company has issued data sheets describing properties and uses of Oronite Alkane, D-40, D-60 dry detergents, Oronite sodium sulfon-


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ELEMI

PROCESSED NATURAL RESINS
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**AMERICAN LECITHIN CO., INC.**
57-01 32nd Ave. Woodside, L.I., N.Y.

ates, and Oronite wetting agents and other surface active agents.

**36.5.16.** The Pacific Lumber Company has issued 5-page bulletin describing Palcotan and Palconate surface active agents.

**36.5.17.** The Rohm & Haas Company has issued Technical Bulletin SAN—230 describing Triton AS-30, anionic surface active agents.

**36.5.18.** The Rohm & Haas Company has issued Technical Bulletin SAN—231 describing AS-35, anionic surface active agent.

**36.5.19.** The Rohm & Haas Company has issued Technical Bulletin SP-127 describing the Priminox Series of polyethoxy Amines, surface active agents.

**36.5.20.** Sharples Chemicals Inc. has issued Data Sheet C-54 describing properties and uses of Nonic 300, a non-ionic type surface active agent.

**36.5.21.** The West Virginia Pulp & Paper Company has issued 7-page Technical Bulletin No. 301 describing properties and uses of Polyfon sodium lignosulfonates—surface active agents.

Manufacturers:
American Cyanamid Company
Antara Chemicals
Armour Chemical Division
Atlas Powder Company
Carbide & Carbon Chemicals Company
Commercial Solvents Corp.
Geigy Industrial Chemicals
The Girdler Company
Hercules Powder Company
Kraft Chemical Company, Inc.
National Aniline Division
Nopco Chemical Company
Nuodex Products Co., Inc.
Oronite Chemical Company
The Pacific Lumber Company
Petrochemicals Company
Raybo Chemical Company
Rohm & Haas Company
Sharples Chemicals, Inc.
West Virginia Pulp & Paper Company
Wyandotte Chemicals Corp.
R. T. Vanderbilt Co., Inc.

### Grinding & Dispersing Aids

**36.6.1.** Kronstein reviews the use of lecithin in pigment dispersion. The effect of lecithin on the dispersion of rutile and of anatase titanium dioxide in latex paints was investigated, together with its effect on the behavior of the pH and viscosity of the paint system.

Results show that the use of lecithin in the preparation of paints increases the speed in which pigment dispersion takes place, thus causing the viscosity of the paint to reach a particular level at a faster rate. These paints also show a steady viscosity level during ten weeks of storage. The addition of lecithin to a prepared paint shows less effect on the paint in subsequent storage.

The preferred amount of lecithin employed in these studies was 1% based on the pigment content. (PVP-32)

**36.6.2.** R. T. Vanderbilt Co., Inc. has issued 4-page bulletin on Darvan No. 1 and Darvan No. 2 describing the properties and uses of these dispersing agents.

**36.6.3.** Nuodex Products Co., Inc. is now introducing its latest paint additive, a grinding aid and dispersing agent—tagged Nuosperse.

Manufacturers:
Advance Solvents & Chemical Corp.
Glyco Products Company, Inc.
Nopco Chemical Co.
Nuodex Products Co., Inc.
R. T. Vanderbilt Co., Inc.

### Emulsifiers

**36.7.1.** Atlas Powder Company presents ten tips on preparing and formulating emulsions. Two series of photographs are presented;


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- **PLYMOUTH ZINC STEARATE XXX-H** *(The Lacquer Grade)*
  Provides ease of production, with low mill-paste viscosity and no foaming. It gives the lacquer excellent sanding characteristics and good film color. Has superior suspension characteristics during storage of your finished product.
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  If you have had a pigment suspension problem, we particularly recommend this stearate. It is excellent as a suspension agent. Also no problems are associated with overbodying during either production or storage.
- **PLYMOUTH ALUMINUM STEARATES** No. 351 "LOW GEL" TYPE
  No. 101 "MEDIUM GEL" TYPE No. 801 "HIGH GEL" TYPE
  No. 351 "Low Gel" Type Aluminum Stearate provides viscosity stability even when your finished product is stored under extreme temperature conditions. It is used for pigment suspension . . . for viscosity control . . . . and as a flatting agent.

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- Dispersions containing Sotex agents improve gloss of enamels and gloss finishes.
- The Sotex agents are specific types of non-ionic and cationic surfactants and are to be used as recommended.

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**Patchem Paterson**

the first dealing with water in oil emulsions, the second with oil in water emulsions. (PVP-25)

**36.7.2.** The Atlas Powder Company has issued 74-page booklet —"A Guide to Formulation of Industrial Emulsions with Atlas Surfactants".

**36.7.3.** The Dow Chemical Company has issued 22-page booklet describing Dow Ethanolamines, emulsifying agents.

**36.7.4.** The Emulsol Corporation has issued 3-page Technical Bulletin No. 38 describing Emcol H-50A, hydrocarbon solvent emulsifier.

**36.7.5.** The Hercules Powder Company has issued 16-page booklet describing Dresinate emulsifiers, detergents and dispersants.

**36.7.6.** The Jefferson Chemical Company Inc. has issued 40-page Technical Bulletin describing properties and uses of mono, di, and tri-ethanolamine, emulsifying agents.

**36.7.7.** The Nopco Chemical Company has issued 3-page Technical Service Data Bulletin describing Monosulph, an emulsifier for water paints.

**36.7.8.** The Oronite Chemical Company has issued data sheets describing properties and uses of Dispersant NI-W and Dispersant NI-O, emulsifying agents.

**36.7.9.** Sharples Chemicals Inc. has issued Report 54-4 describing Sharples emulsifier amines for water emulsion floor polishes.

Manufacturers:
Antara Chemicals
Armour Chemical Division
Atlas Powder Company
Carbide & Carbon Chemicals Company
The Dow Chemical Company
Emery Industries, Inc.
The Emulsol Corp.
Geigy Industrial Chemicals
Hercules Powder Company
Jefferson Chemical Company, Inc.
Kraft Chemical Company, Inc.
Nopco Chemical Company
Oronite Chemical Company
Petrochemicals Company
Sharples Chemicals, Inc.
Universal Chemicals Corp.
Wyandotte Chemicals Corp.

### Stabilizers

**36.8.1.** Ronai & Weisberg discuss the use of modified proteins to stabilize latex paints. The reaction between protein stabilizers & polyvalent cations in a latex paint usually causes a great viscosity increase and makes the paint unusable. Proteins modified to be insensitive to polyvalent cations could help prevent this. Modification of a protein could affect its capacity to make stable emulsions, thereby improving freeze-thaw stability. (IEC-53)

**36.8.2.** Hundreds of compounds have been suggested as stabilizers to protect polyvinyl chloride against breakdown by heat and light. Mack reviews the theory of the action of the stabilizers and discusses the merits of the various commercial types, including lead, calcium, strontium, barium, tin, cadmium, and zinc compounds.

Recent developments in epoxy stabilizers and chelating materials are described. The latter are complexing agents which serve to clear up haziness caused by some metallic compounds as well as to improve the stabilization of the vinyl resin. Synergistic effects are obtained by the use of combinations of metallic stabilizers, resulting in greater protection than is imparted by either component used alone in like quantity. (MP-8)

**36.8.3.** A plasticised, heat- and light resistant, stably compatible composition comprising a resin selected from the group consisting of homopolymers of vinylidene chloride and copolymers thereof with up to 15%, based on the weight of said copolymers, of other unsaturated compounds copolymerizable therewith, together with


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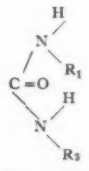
from 0.5 to 10%, based on the weight of said resin, of a chloro substituted phenyl benzoate selected from the group consisting of the following compounds:
Phenyl p-chlorobenzoate
Phenyl o-chlorobenzoate
p-Chlorophenyl benzoate
p-Chlorophenyl p-chlorobenzoate
p-Chlorophenyl o-chlorobenzoate
p-Chlorophenyl 3,4-dichlorobenzoate
o-Chlorophenyl benzoate
o-Chlorophenyl p-chlorobenzoate
o-Chlorophenyl o-chlorobenzoate
2,4,6-trichlorophenyl benzoate
2,4,6-trichlorophenyl p-chlorobenzoate
2,4,6-trichlorophenyl o-chlorobenzoate
2,4,6-trichlorophenyl 3,4-dichlorobenzoate
2,4,6-trichlorophenyl 2,4-dichlorobenzoate
Pentachlorophenyl benzoate
(USP-76)

**36.8.4.** A heat-stabilized composition comprising a crystalline resin selected from the group consisting of polymers of vinylidene chloride and copolymers thereof with other ethylenically unsaturated compounds copolymerizable therewith, said copolymers containing at least 80% of vinylidene chloride copolymerized therein, together with from 0.5 to 4.0% of pentachlorophenoxy propene oxide homogeneously compounded therewith, said percentages being on the basis of the weight of said resin. (USP-77)

**36.8.5.** A method of stabilizing an emulsion copolymer comprising an aromatic vinyl compound containing a single center of unsaturation and a conjugated diolefin



U. S. Patent No. 2,683,699

having the qualities essential to a paint latex which comprises dispersing therein from 1% to 15% of a water-soluble compound containing a ureylene nucleus wherein $R_1$ and $R_2$ are radicals selected from the group consisting of hydrogen, hydroxyl, alkyol and alkyl radicals containing not more than four carbon atoms wherein the sum of the carbon atoms in $R_1$ plus $R_2$ does not exceed 5. USP-152)

**36.8.6.** The Carbide & Carbon Chemicals Company has issued 2-page Bulletin F-8426 describing properties and uses of stabilizer D-22, dibutyl in dilaurate.

**36.8.7.** The Metal & Thermit Corporation has issued Technical Data Sheets 112, 122, and 123 describing Thermolite 31, 14, and 99, a series of stabilizers for vinyls and other chlorinated organic compounds.

**36.8.8.** The Minnesota Mining & Manufacturing Company has issued 4-page Report No. 2 describing RD-910 Latex Paint Stabilizer-Thickener.

**36.8.9.** The Witco Chemical Company has issued Bulletin S-8 describing Witco Stayrite #229, a lead compound for stabilizing halogen containing organic materials.

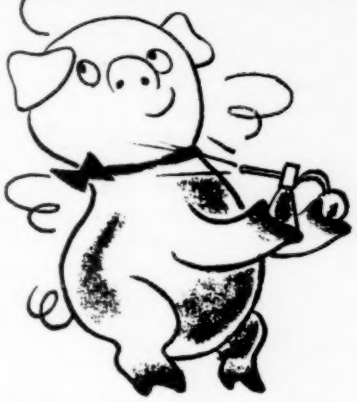
Manufacturers:
Advance Solvents & Chemical Corp.
Carbide & Carbon Chemicals Company
Ferro Chemical Corp.
The Harshaw Chemical Company
Harwick Standard Chemical Company
Metal & Thermit Corp.
Minnesota Mining & Mfg. Company
National Lead Company
Nopco Chemical Company
Witco Chemical Company

### Thickeners

**36.9.1.** Rodriguez discusses the peptization of aluminum soap-mineral spirits mixtures. The purpose of this work was to evaluate the effect of certain polar compounds on the gelling rate and equilibrium viscosity of aluminum octoate-mineral spirits mixtures at room temperatures. (APJ-39)

**36.9.2.** A method of making a mixture of water with a zein solution, which consists in dissolving the zein initially in a substantially anhydrous glycol which is a primary solvent for zein, said glycol being substantially non-volatile at 130° C. under a pressure of 760 mm. of mercury and having a critical peptization temperature whose maximum is minus 40° C. to make an initial substantially anhydrous solution which remains clear and stable at 21° C. for at least six weeks, and then adding water to said initial solution, the water being added sufficiently slowly and with sufficiently vigorous agitation to blend with said initial solution without precipitation of


odor control



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the zein, the weight of the added water being at least 10% of the weight of the mixture and being within the water tolerance of said primary solvent. (USP-47)

**36.9.3.** The American Polymer Co. has issued Bulletin P-27 on Acrylic Thickeners and Protective Colloids Polycos 296 and 296N.

**36.9.4.** The Attapulgus Minerals & Chemicals Corporation has issued 8-page Bulletin No. P53 describing "Permagel—the ideal bodying and thickening agent in organic or water systems".

**36.9.5.** The Burtonite Company, has issued Technical Data bulletin on Burtonite #7, a cold water soluble gum made from Guar seeds. Used as a protective colloid, thickener, and film forming agent.

**36.9.6.** The B. F. Goodrich Chemical Co. has issued Service Bulletin GC-20 describing properties and uses of Carbapol 934, an unique water sensitive gum, useful as an emulsion paint thickener.

**36.9.7.** The Nopco Chemical Company has issued 3-page Technical Service Data Bulletin Misc. 36a—"Higher Latex Paint Thickening Efficiency with Modicol VD".

cf: 40.1.3
Manufacturers:
Advance Solvents & Chemical Corp.
Brown-Allen Chemicals, Inc.
Buckeye Cotton Oil Company
Carbide & Carbon Chemicals Company
Croda Incorporated
Minnesota Mining & Mfg. Company
National Lead Company
Nuodex Products Co., Inc.
Raybo Chemical Company
Rohm & Haas Company
Witco Chemical Company

### Waxes

**36.10.1.** Johnson studied solid-solid transitions in commercial paraffin waxes and normal straight-chain hydrocarbons by measuring the refractive index as a function of temperature. Typical waxes have solid-state transitions similar to those of the normal straight-chain hydrocarbons in the same molecular weight range.

Because few properties of waxes in the solid state can be measured conveniently and accurately, use of the information obtained by this method should lead to a better understanding of the behavior of waxes. (IEC-56)

**36.10.2.** The ASTM Wax Polishes Committee presents two suggested methods relating to carnauba and other waxes. The first is a method for concentrating additives of carnauba wax and other high-melting point natural and synthetic waxes. The second is a suggested method of test for the index of refraction of carnauba wax and other high-melting point natural and synthetic waxes. (ASTM-10)

**36.10.3.** Knol reviews the aliphatic woolwax alcohols. The composition of the group of aliphatic woolwax alcohols has been the subject of investigation by many chemists for more than 60 years. Systematic research started in 1951. Twenty-two alcohols have been isolated, belonging to four series of alcohols: normal alcohols, diols, iso, and ante-iso branched chain alcohols. None of the investigators mentions the presence of unsaturated alcohols. About 25% of the woolwax alcohols is still unknown material and waiting for further elucidation. (JAOCS-14)

**36.10.4.** It should be possible to produce plastics from peat wax. Molecular structure suggests potential chemical uses. Peat wax consists of a series of high molecular weight organic compounds containing three or more functional groups such as carboxylic acid, ester and hydroxyl. An arbitrary division can be made of crude wax into resins, true wax and asphalt. (CEN-20)

**36.10.5.** An emulsifier composition comprising (*a*) a mixture of lipophilic partial ester of a long chain fatty acid and a hydrophilic polyhydroxylic organic compound, a highly hydrophilic hydroxy-polyoxyethylene ether of a lipophilic partial ester of a long chain fatty acid and a hydrophilic polyhydroxylic organic compound, said hydroxypolyoxyethylene ether containing at least 10 oxyethylene groups; said partial ester and said hydroxypolyoxyethylene ether being present in the mixture in such proportions that the ratio of oxyethylene groups in said hydroxypolyoxyethylene ether to the total ester groups (both in the free ester and in the hydroxypolyoxyethylene ether) is in the range of from about 1.5 to 9.0 and (*b*) from about 3% to about 25% by weight, based on the weight of the said mixture, of a hexitol monoborate the pH of which has been adjusted to a value between 4.5 to 9.0 by replacement of acid hydrogen of the said monoborate with a monovalent cation other than hydrogen.

An emulsifiable wax consisting essentially of from 70% to 90% paraffin wax and from 30% to 10% of the emulsifier composition of claim 1. (USP-155)

**36.10.6.** The Glyco Products Company, Inc. has issued 16-page booklet describing Synthetic Waxes by Glyco.

**36.10.7.** The Frank B. Ross Co., Inc. has issued 22-page Booklet describing Ross Waxes.

cf: 20.3.1
35.7.1
Manufacturers:
Bakelite Company
H. L. Barnebey
Dura Commodities Corp.
Glyco Products Co., Inc.
National Wax Company
Frank B. Ross Company
Standard Oil Co. of Calif.

### Anti-Foaming Agents

**36.11.1.** The Monsanto Chemical Company has issued technical data sheet describing defoamer PC 1244.

**36.11.2.** The Nopco Chemical Company has issued 2-page Technical Service Data Bulletin Misc. 17 describing Nopco Anti-Foamers for Latex Paints Nopco 1497-V, 1407, and 1907-B.

Manufacturers:
Dow Corning Corp.
El Dorado Oil Works
Glyco Products Co., Inc.
Kraft Chemical Company, Inc.
Monsanto Chemical Company
Nopco Chemical Company
Swift & Company

### Ultra-Violet Absorbers

**36.12.** (No abstracts)

Manufacturers:
American Cyanamid Company
Antara Chemicals

### Fire-Retardants

**36.13.1.** Method for the preparation of a stable solution capable of imparting fire resistance to a cellulosic material which comprises forming a mixture of water, hydrochloric acid and antimony trioxide and an organic acid selected from the group consisting of acetic acid and formic acid, and to said mixture subsequently adding substantially anhydrous titanium tetrachloride, meanwhile maintaining the temperature of said mixture be-

tween 30 and 50° C. during the addition of said titanium tetrachloride, said organic acid being added in an amount from 0.3 to 0.9 part by weight of organic acid for each part by weight of titanium tetrachloride, said antimony trioxide being added in an amount by weight from 0.46 to 0.7 part of antimony trioxide for each part by weight of titanium tetrachloride, said hydrochloric acid and said titanium tetrachloride being added in amount to give 0.16 part by weight of chloride, calculated as hydrochloric acid for each part by weight of antimony trioxide, and from 0.19 to 0.58 part by weight of chloride calculated as hydrochloric acid for each part by weight of titanium calculated as titanium tetrachloride and adding water in an amount to maintain in the final solution a concentration of between 120 and 160 grams of titanium per liter of solution. (USP-98)

**36.13.2.** An intumescing fire-retarding composition composed of the water-insoluble reaction product of phosphoryl chloride and anhydrous ammonia, said water-insoluble product having a nitrogen/phosphorus ratio between 1.72:1 and 1.80:1, in combination with an alkyd resin having free hydroxy radicals. (USP-129)

**36.13.3.** The American Potash and Chemical Corporation has issued Product Information Bulletin DEB—115 describing the properties and uses of Borotherm, a highly soluble borate composition.

**36.13.4.** The Metal & Thermit Corporation has issued Technical Data sheets 119 and 128 describing antimony oxide in vinyl plastics and presenting data on M & T Flame Retarder.

Manufacturers:
American Potash & Chemical Corp.
Metal & Thermit Corp.
Pacific Coast Borax Company.

### Anti-Skinning Agents

**36.15.** (No Abstracts)

Manufacturers:
Advance Solvents & Chemical Corp.
National Aniline Division
Nuodex Products Co., Inc.

### Deodorants

**36.14.** (No Abstracts)

Manufacturers:
Aromatic Products, Inc.
Dodge & Olcott, Inc.
Rhodia, Inc.
Sindar Corporation
Van Amerlingen-Haebler, Inc.

# INTERMEDIATES

## CHAPTER 37

# INTERMEDIATES

### General

**37.1.1.** Adams describes the production of intermediates for azo pigments and lakes. Originally used in the dyestuffs industry, the term "intermediate" has now come to mean any organic chemical which is treated further chemically to produce such finished products as dyestuffs, lakes, insecticides, pharmaceutical products, etc. The intermediates are derived generally from coal tar distillation products such as benzene, toluene, xylene, and naphthalene by one or more chemical processes.

The following diazo components are discussed: 3-Nitro-p-toluidine, p-Nitroaniline, C-acid, and Tobias acid. The following coupling components are discussed: 2:3-Hydroxynaphthoic acid and Acetoacetarylides. (JOCCA-37)

**37.1.2.** Expanding acrylonitrile consumption and new acetylenics will boost chemical consumption of acetylene.

Acetylene chemistry is still in the early development stages; its future cannot be accurately evaluated. But there is no doubt that as technology makes more, cheaper, purer acetylene available chemistry will find many valuable uses for this versatile, convenient gas. (CEN-17)

**37.1.3.** Oswald makes some observations on the use of dimethyl isophthalate (DMI), a new alkyd raw material. Use of the alcoholysis reaction with DMI leads to the following advantages as compared with fusion esterification using phthalic anhydride:

1. greater latitude in choice of reaction temperature
2. elimination of sublimation problems
3. higher viscosity for a given polyol and oil length
4. lower acid number resins
5. more positive control of rate of viscosity increase
6. better color

(POCR-2)

**37.1.4.** The Sun Oil Company has opened a new petrochemical plant at Marcus Hook, Pa. Unknown 35 years ago, the petrochemical industry now supplies almost one-quarter of our chemical needs and promises to supply one-half by 1965. (PIM-5)

**37.1.5.** The method comprising heating a reaction mass consisting essentially of calcium cyanamide, ammonia and carbon dioxide at a temperature of at least about 65°C. and a pressure of at least 450 p.s.i. to produce a reaction mass containing at least one member of the group consisting of a guanidine salt and melamine. (USP-57)

**37.1.6.** The process of preparing melamine from biuret which consists of heating biuret at a temperature in the range of 300-350°C. in a closed vessel under a pressure of at least 100 lbs. per sq. inch, until melamine is formed and recovering the so-formed melamine. (USP-58)

**37.1.7.** The Commercial Solvents Corporation has issued Technical Data Sheet TDS—No. 22 describing anhydrous ammonia.

**37.1.8.** The Dow Chemical Company has issued 14-page technical bulletin describing chlorinated benzenes, chemical intermediates.

**37.1.9.** The Monsanto Chemical Company has issued 16-page Technical Bulletin No. O-116 describing reactions and properties of succinonitrile.

**37.1.10.** The National Aniline Division has issued Technical Bulletin Nos. 1-3 and 1-4 describing trans-1,2-dibenzoylethylene and 1,4-naphtho-quinone.

**37.1.11.** The National Aniline Division has issued Technical Bulletin No. 1-7 describing fumaryl chloride.

**37.1.12.** The Nitrogen Division, has issued 33-page product bulletin describing properties and uses of ethylene oxide, ethylene glycol and diethylene glycol.

**37.1.13.** The Rohm & Haas Company has issued 11-page Technical Bulletin SP-98 describing octylphenol and nonylphenol.

**37.1.14.** A new intermediate in the production of epoxy resins is the latest offering of Irvington Varnish and Insulator Division of Minnesota Mining and Manufacturing Co., Irvington, N. J. Trade named Cardolite 6463, the product is a phenol, containing a 15-carbon substituted straight chain in the metaposition, Molecular weight: 410, nearly twice that of the usual bisphenol. According to Irvington, Cardolite 6463 requires about half the quantity of epichlorhydrin normally used in the preparation of epoxies, imparts greater flexibility to the cured resin.

### Polybasic Acids

**37.2.1.** Defense Production Administration goal set for phthalic anhydride facilities hasn't appealed to many chemical companies. One of the five companies filing for write-offs has cancelled, another is still undecided whether to expand. The three others—Allied, Cyanamid and Monsanto—are due to boost production by some 80 million lbs. before January 1, 1955. (CW-4)

*The only producer of all these*

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In the industry's two newest and most modern plants at Moundsville, W. Va. and Hopewell, Va. and in our long established Buffalo, N. Y. plant, we produce a greater volume of a longer line of dibasic acids and anhydrides than any other resin-chemical supplier. Multi-plant production assures continuity of supply. Our long experience in resin-chemical development assures uniformly high quality. Data, samples and prices on these or related chemicals sent on request.

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**Nadic Anhydride Adipic Acid Succinic Anhydride**
**Maleic Acid Malic Acid Succinic Acid**
**Metaphenylenediamine Dodecenylsuccinic Anhydride**

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**NATIONAL ANILINE DIVISION**
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Boston Providence Philadelphia Chicago San Francisco Portland, Ore Greensboro
Charlotte Richmond Atlanta Columbus, Ga New Orleans Chattanooga Toronto

**37.2.2.** Gardner discusses maleic anhydride adducts. The major uses of maleic anhydride have been confined to the protective coatings field wherin more than 86% of the total production of maleic anhydride is used. Major uses include alkyd resins, polyester and styrene resins, and plasticizers. (PVP-24)

**37.2.3.** By the end of 1954 National Aniline Division of Allied Chemical & Dye Corp., will have added 10 million lbs. to U. S. maleic anhydride capacity and about 1 million lbs. to its fumaric capacity.

Maleic anhydride tops fumaric acid use in styrenated polyesters. Fumaric acid gives a higher heat-distortion temperature to a resin than does maleic anhydride, other things being equal.

Substitution of fumaric acid for maleic anhydride is on a mole-for-mole basis; therefore a greater weight of fumaric acid is required to replace a functionally equivalent weight of maleic anhydride.

In alkyds, its been found that the substitution of fumaric acid for phthalic anhydride—to the extent of 1.5-3% of total alkyd resin weight—improves resulting protective coatings. Films dry faster, become harder and more durable, resist water and alkalis, have clearer colors that are retained longer than when none of the phthalic anhydride is replaced. (CW-17)

**37.2.4.** The American Cyanamid Company has issued 24-page booklet on "Aero Phthalic Anhydride" listing properties and methods of handling.

**37.2.5.** The American Cyanamid Company has issued 2-page bulletin describing properties and uses of Aero maleic anhydride.

**37.2.6.** The Carbide & Carbon Chemicals Company has issued 32-page technical booklet describing uses and properties of organic acids.

**37.2.7.** E. I. du Pont de Nemours & Co. (Inc.) has issued 6-page technical bulletin describing properties and uses of pyromellitic acid, a new polycarboxylic acid.

**37.2.8.** E. I. du Pont de Nemours & Co. (Inc.) has issued 4-page technical bulletin describing properties and uses of isocinchomeronic acid, a new heterocyclic dibasic acid.

**37.2.9.** Emery Industries, Inc. has issued 16-page booklet describing properties and uses (general applications and in surface coatings) of Emery 955 Dimer Acid, a dibasic acid of approximately 600 molecular weight.

**37.2.10.** Emery Industries, Inc. has issued Technical Bulletin No. 40-A describing Emerox 1110 Azelaic acid, $C_7 H_{14} (COOH)_2$.

**37.2.11.** The Hercules Powder Company has issued 4-page bulletin describing properties and uses of Hercules DMT, dimethyl terephthalate.

**37.2.12.** Koppers Company, Inc. has issued 4-page bulletin #C-O-44 describing properties and uses of phthalic anhydride.

**37.2.13.** The Monsanto Chemical Company has issued 10-page Technical Bulletin No. 0-115 describing "Fumaric Acid in Coating and Polyester Resins".

**37.2.14.** The National Aniline Division has issued Technical Bulletin Nos. I-1 and I-2 describing tetrahydro phthalic anhydride and hexahydro phthalic anhydride.

**37.2.15.** The National Aniline Division has issued Technical Bulletins Nos. I-5 and I-6 describing "nadic" anhydride and beta benzoyl-acrylic acid.

**37.2.16.** The National Aniline Division has issued Technical Bulletins Nos. I-8 and I-9 describing dodecenyl-succinic anhydride and thiomalic acid.

**37.2.17.** Chas. Pfizer & Co., Inc. has issued 6-page Technical Bulletin No. 46 describing properties and uses of fumaric acid, an unsaturated dibasic acid.

**37.2.18.** The Shell Chemical Corporation has issued 4-page bulletin SC:54-33 describing p-tert-butylbenzoic acid. Bulletin SC:51-25 describes the use of this acid in surface coating resins.

**37.2.19.** The Velsicol Corporation has issued 13-page booklet describing properties and uses of chlorenic acid and chlorenic anhydride.

cf: 50.3.1

Manufacturers:
American Cyanamid Company
Archer-Daniels-Midland Company
Carbide & Carbon Chemicals Company
E. I. duPont de Nemours & Co., Inc.
Emery Industries, Inc.
Hercules Powder Company
Koppers Company, Inc.
Monsanto Chemical Corp.
National Aniline Division
Chas. Pfizer & Co., Inc.
Shell Chemical Corp.
Velsicol Corp.

### Polyols

**37.3.1.** Pattison reviews glycerine—today and tomorrow. It seems safe to say that 1954 will find glycerine supply fully adequate to meet the demands of an economy of abundance. It should be free from the "feast or famine" effects that have driven customers to seek substitutes in the past, or to anticipate indigestible market gluts. (PVP-28)

**37.3.2.** Pattison discusses the use of glycerine in industrial finishes. About one-third of all the glycerine produced in this country is used in industrial finishes, as synthetic resins. Glycerine is used in alkyd resin manufacture, where it permits flexibility in alkyd resin formulations. Alkyds blended with other resins improve the properties of both (OF-14)

**37.3.3.** Balgley discusses trimethylolethane (TME), a new polyol for the coatings industry. Advantages of TME in alkyds include: light initial color, good color retention, hardness, fast dry, excellent alkali resistance compared to other alkyds, good durability, heat stability, compatibility with amino resins, fast alcoholysis, and non-volatility. (APJ-29)

**37.3.4.** Balgley describes trimethylolethane (TME) a new polyol for the coatings industry. Advantages of TME in alkyds are as follows:

1. light initial color
2. good color retention
3. hardness
4. fast dry
5. excellent alkali resistance compared to other alkyds
6. good durability
7. heat stability
8. compatibility with amino resins
9. fast alcoholysis
10. non-volatile

(PIM-20)

**37.3.5.** A substantially homogeneous liquid composition consisting of a dispersion of at least one alkali salt of a sulphonated alkenyl aromatic resin, containing an average of from 0.55 to 0.95 sulphonate radical per aromatic nucleus, in a liquid medium of the group consisting of at least one

saturated aliphatic polyhydric alcohol containing from 2 to 6 carbon atoms, and having a ratio of from 1 to 1.5 carbon atoms per atom of oxygen, in the molecule, and aqueous solutions of such saturated aliphatic polyhydric alcohols in a concentration of at least 30 per cent by weight, said salt of the sulphonated alkenyl aromatic resin being present in an appreciable proportion not greater than 10 per cent of the combined weight of the same and the liquid medium. (USP-99)

**37.3.6.** The Atlas Powder Company has issued 16-page booklet "Sorbitol Resins" describing the use of Sorbitol, a versatile polyol for alkyd and resin synthesis.

**37.3.7.** The Glycerine Producers' Association has issued 19-page bulletin on Glycerine—for product conditioning.

**37.3.8.** The Heyden Chemical Corporation has issued 10-page revised Technical Data Sheet PE-10 describing properties and uses of TME—trimethylolethane, a solid trihydric alcohol.

**37.3.9.** The Heyden Chemical Corporation has issued 32-page booklet "Pentek Resins for Protective Coatings of Enduring Beauty, High Resistance to Water, Weather and Severe Service. These resins are based on Pentek, pentaerythritol (tetramethylolmethane).

cf: 14.2.1
Manufacturers:
Atlas Powder Company
Commercial Solvents Corp.
Eastman Chemical Products, Inc.
Wyandotte Chemicals Corp.

### Aldehydes

**37.4.1.** There is good reason to believe that the United States will reach its formaldehyde goal of 1,675 million lbs. capacity by 1955. (CW-6)

**37.4.2.** The Celanese Corporation of America has issued 28-page Formalin Handling Manual. This manual covers specifications for formaldehyde, receiving and unloading, temperature control, temperature-density table, storage, safety & personnel protection, and methods of analysis.

**7.4.3.** The Westvaco Chemical Division has issued 4-page Technical Data Sheet S-7 (Revised) describing properties and reactions of dichloroacetaldehyde.

**37.4.4.** The Westvaco Chemical Division has issued 26-page Technical Bulletin No. 206 describing Chloral, trichloroacetaldehyde.

Manufacturers:
Celanese Corp. of America
Commercial Solvents Corp.
Heyden Chemical Corp.
Westvaco Chemical Division

### Phenols

**37.5.1.** Given a healthy assist from a flood of new cumene-phenol plants on which construction started this year, the Defense Production Administration's goal for phenol production by January 1, 1955 is already assured of being met. The goal: an additional 280 million lbs. above 1951 capacity of 343 million lbs. (CW-1)

**37.5.2.** Phenol supply is still "in balance" as new developments expanding outlets push demand skyward, blot up surplus production capacity. Defense Production Administration set a January 1955 goal of 623 million lbs. But kinks in new phenol-from-cumene process threaten to tighten the market unless straightened out by 1955. (CW-9)

**37.5.3.** Plant in California starts production of phenol, via cumene, from 100% petroleum sources, Output: 17,500 tons. (CEN-7)

**37.5.4.** The Monsanto Chemical Company has issued 32-page booklet on the Handling of Phenol.

Manufacturers:
Monsanto Chemical Company
Rohm & Haas Company

### Monomers

**37.6.1.** Dow's styrene oxide, outgrowing its pilot plant, is being geared up to commercial production. Styrene glycol, made directly from styrene oxide, may be used to modify alkyd resins. Other interesting resins result from the polymerization of styrene oxide with phenol, vinyl halides and vinylidine halides. (CW-7)

**37.6.2.** Coffman & Jenner have obtained the acetates of alcohols containing from one to several styrene units, by the ionic telomerization of styrene with acetic acid. Esters containing 1,2, and 3 units have been isolated. From styrene and acetonitrile, acyl derivatives of primary amines having a number of styrene units have been obtained, and amines from the first two members have been identified. Styrene & HCHO in acetic acid have given the acetates of glycols containing one methylene group and and a variable number of styrene units. (JACS-53)

**37.6.3.** Frankel, et al, report that acyl chlorides hydrochlorides of amino acids and peptides undergo polymerization, yielding polymeric polypeptides. This method is applicable in cases where N-carboxy-anhydrides cannot be obtained, as with $\beta$-amino acids and peptides. (JACS-54)

**37.6.4.** Fuhrman & Mesrobian measured the chain transfer constants of six vinyl monomers with carbon tetrabromide at several temperatures. The monomers employed, in the order of their decreasing transfer constant at 60° are: vinyl acetate, p-chlorostyrene, styrene, methyl acrylate, methyl methacrylate and methacrylonitrile. The results indicate that ionic forms in the transition state, similar to those involved in radical addition to double bonds, contribute to the reactivity of radicals in transfer reactions. (JACS-56)

**37.6.5.** Hush presents a quantum-mechanical discussion of the gas-phase formation of quinonedimethide monomers. Included are: formation of monomers, alternate SQDM reactions, energies and kinetics of elementary steps, calculation of unsaturation energies, comparison with experiment, excited states of QDM monomers, cross-linkage, and conclusion. (JPS-1)

**37.6.6.** Vinyltoluene, first cousin to styrene, has a big future in store. It is compatible over a much larger range of drying oils than is styrene. VT's ease of reaction is an improvement over styrene resulting in economies. VT-drying oil copolymers possess infinite tolerance for petroleum naphtha solvents of low Kouri butanol value. (POCR-11)

**37.6.7.** Isocyanates are compounds characterized by the polyfunctional group —N = C = O. They are highly reactive compounds. The reaction of an alcohol with an isocyanate results in a linear polymer. Currently the isocyanates are largely in the development stage in this country. (POCR-13)

**37.6.8.** Henson reviews and discusses vinyltoluene—a new spoke in the vehicle wheel. Chemically

it is methylstyrene. An entirely new class of vehicles made possible by a combination of vinyltoluene and divinylbenzene shows strong possibilities for the preparation of vehicles closely resembling oil modified alkyds in many important characteristics. (POCR-14)

**37.6.9.** Henson discusses vinyltoluene a new monomer for vehicle manufacture, Vinyltoluene, which can also be called methylstyrene, is related to styrene hence a vinyl monomer. The introduction of vinyl monomers results in modified or upgraded vehicles. (APJ-16)

**37.6.10.** Henson discussed vinyltoluene, a new spoke in the vehicle wheel. Vinyltoluene is related to polystyrene—another name for it being methylstyrene. This monomer opens an entirely new and scarcely explored field of vehicle chemistry. The speed and readiness with which it reacts with oils and oil modified alkyds is very favorable. (PIM-4)

**37.6.11.** The Carbide & Carbon Chemicals Company has issued 8-page technical bulletin describing properties and uses of acrylonitrile (vinyl cyanide).

**37.6.12.** The Dow Chemical Company has issued 5-page bulletin describing butylene oxides S used directly for polymerization and condensation type reactions.

**37.6.13.** The Dow Chemical Company has issued 47-page bulletin on vinyltoluene for use in paints and varnishes.

**37.6.14.** The Dow Chemical Company has issued 21-page bulletin describing properties and uses of vinyl chloride monomer.

**37.6.15.** Koppers Company, Inc. has issued 36-page Technical Bulletin C-4-119 describing properties and uses of styrene monomer.

**37.6.16.** Koppers Company, Inc. has issued 23-page bulletin describing properties and uses of styrene monomer.

**37.6.17.** The Rohm & Haas Company has issued 32-page Technical Bulletin SP-42 describing properties and uses of calcium acrylate, a monomeric, water-soluble salt, which will polymerize in the presence of catalyst.

**37.6.18.** The Rohm & Haas Company has issued 14-page bulletin SP-88 describing properties, handling and reactions of glacial methacrylic acid.

**37.6.19.** The Rohm & Haas Company has issued 2-page bulletin SP-139 describing properties and uses of methoxyethyl acrylate and butoxyethyl acrylate.

cf: 16.2.2
18.1.1

Manufacturers:
American Momomer Corp.
Carbide & Carbon Chemicals Company
The Dow Chemical Company
Koppers Company, Inc.
Monsanto Chemical Company
National Aniline Division
Rohm & Haas Company

# SOLVENT TYPE COATINGS

## CHAPTER 38

# ARCHITECTURAL COATINGS

### General

**38.1.1.** Graham presents data on the rate of diffusion of various solvents into dried oleoresinous varnish films and of the equilibrium swelling produced by solvents on dried linseed stand oil films. The effects of solvents on the physical properties of dried varnish films are discussed, and effects of age and temperature on brittleness is illustrated by experimental data. (JOCCA-3)

**38.1.2.** New entries in the odorless paint field underline the rising importance of "easy on the nose" paints. Odorless paints have been smaller paint-maker's answer to water-based paints. But chances are they'll eventually take over wherever consumers object to painty smells, despite cost of raw materials, and formulation problems—the chief drawbacks. Already alkyd reduction techniques have simplified paint manufacture. (CW-13)

**38.1.3.** Under the auspices of a vast European Assembly of the Chemical Arts, the 26th Congress of Industrial Chemistry and the 2nd Salon of Chemistry were held in Paris at the Park des Expositions, reports Rabate. Addresses in Section 15, representing paints, pigments, varnish and inks, gave a considerable viewpoint on the varied problems currently being investigated. These include the effect of water and aqueous solutions on paints, problems on paint thixotropy, the use of microscopes for measuring the surfaces of small particles, and measuring film thicknesses by the back-scattering radiographic method. (PM-2)

**38.1.4.** Plastic paints are becoming more popular and in this article their diverse applications are described by Gower. Writing as a decorator, the author emphasizes the importance of knowing the value and limitations of each product and points out the advantages of water-based over oil-bound types. (PM-46)

**38.1.5.** Madson & Lilley present a study on the effect of toning agents on the hiding power of white architectural enamels.

Data have been presented to show the effect of 8 toning agents on white architectural enamels.

The effect of four spreading rates and five $TiO_2$ concentrations on the shape of hiding power and apparent reflectance curves has been discussed.

Medium Chrome Yellow gave the smallest contrast ratio increase per unit decrease in apparent reflectance as measured by the multipurpose reflectometer.

Opinions regarding visual hiding power of Medium Chrome Yellow toned paints varied. Optimum eye sensitivity appears to be a major contributing factor to these differences of opinion.

The other seven colors used gave approximately equal increases in contrast ratio per unit of apparent reflectance decrease. In other words, a given apparent reflectance at a given contrast ratio is possible with any of these seven colors.

The curves will permit the selection of the required amount of $TiO_2$ per gallon to achieve a given hiding power at a given brightness level for the range covered by the eight different colors.

From a cost standpoint, Bone Black appears to be the cheapest toning agent followed by Ultramarine Blue and BON Red.

Finally, the results show that the addition of most colors increases the hiding power of the enamels—in no case did the additions cause a decrease in contrast ratio. (OD-4)

**38.1.6.** Elm discusses the mechanical properties of protective coatings films and particularly with the influence exerted by pigments. An effort is made to relate these properties to the molecular structure of the paint materials examined in the hope that a better understanding of these relationships might point the way to further advancements in the field of organic protective coatings. The mechanical properties discussed include only those which are inherent in the film and may be considered independent of the film's relationship with the substrate to which it might happen to be attached. They comprise primarily strength and distensibility.

The relationship between the strain or deformation resulting from a given stress on the coating is the stress-stain diagram. Stresses applied to coatings can be constant or they can be dynamic (stresses which increase at an arbitrary but steady rate). Factors which influence the stress-strain diagram are rate of loading, temperature, humidity, and age of specimen.

Perhaps the greatest influence upon the mechanical properties of coatings films, however, is exerted by pigmentation. As the pigment concentration increases the film loses distensibility and increases in stiffness and strength. Other factors affecting the properties of the film are particle shape, particle size, and the nature of the surface.

The aging behavior of coatings is largely dependent on changes in their plastic properties and, therefore, it is not too difficult to esti-

make their probable service behavior from their stress-strain properties. (OD-5)

**38.1.7.** Elm presents part I of "a New Look at Paint Films", the J. J. Mattiello Lecture for 1953 which he delivered at the Federation of Paint & Varnish Production Clubs Convention in Atlantic City. First printed in the Official Federation Digest. (CPVM-14)

**38.1.8.** Moore, in lecture XV in the Third Ten-Year Practical Paint Course sponsored by the New England Production Club, discusses reasons why paints do not give expected service. This lecture was illustrated with 22 slides, which are reproduced in this article, illustrating various causes of failure. (APJ-21)

**38.1.9.** Lundgren, in Lecture XVIII in the Third Ten-Year Practical Paint Course sponsored by the New England Production Club, discusses the advantages of interior design over interior decorator. To decorate is to trim, as we decorate Christmas trees or cakes. The more correct term is design and painting should be an integral part of the design of a house rather than a mere decoration. (APJ-25)

**38.1.10.** A staff report (Paint, Oil & Chem. Rev.) reviews house paints.

Part I covers:

I Introduction
II White Pigments for House Paints
  A. Primary Pigments
  B. Secondary Pigments
  C. Extender Pigments
III Tinted and Colored Pigments for House Paints
  A. Tint Base Pigments
  B. Pigments for Dark House Paints (POCR-31)

**38.1.11.** Paint, Oil and Chemical Review presents Part II of a staff report on house paints. This includes:

IV Vehicles for House Paints
  A. Linseed Oil
  B. Other Vegetable Oils
  C. Dehydrated Castor Oil
  D. Resinous Additives
  E. Tall Oil
  F. Emulsion Vehicles
  G. Alkyd Resin Vehicles (POCR-32)

**38.1.12.** Paint, Oil and Chemical Review presents Part III of a staff report on house paints. It includes:

I The Formulation of House Paints
  A. White House Paints
  B. Tint Bases
  C. Dark Colored House Paints
  D. Primers
  E. One Coat House Paints (POCR-34)

**38.1.13.** Paint, Oil and Chemical Review presents Part IV of a staff report on house paints. This fourth and concluding part includes:

I The Formulation of House Paints (Concluded)
  F. House Paints Based on Alkyd Resins and other Synthetic Vehicles
  G. Emulsion Paints
  H. Miscellaneous Formulations
II Relationship of the Wooden Surface to House Paint
III Application of House Paint
IV Testing of Exterior Durability
V Preparation of House Paint
VI Summary (POCR-35)

**38.1.14.** The American Zinc Sales Company has released their study on exterior formulation trends. 14 year study reveals validity of earlier studies—titanium zinc and "war oil ratio" resist change—DCO enters the picture—calcium pigment gains.

Full details are found in report available from American Zinc Sales Co. (POCR-36)

**38.1.15.** Elm presents part III of his paper "A New Look at Paint Films," based on the Joseph J. Mattiello Lecture delivered by the author at the Federation of Paint & Varnish Production Clubs Convention in Atlantic City in 1953. (CPVM-18)

**38.1.16.** Elm presents part III of his paper "A New Look at Paint Films" based on the Joseph J. Mattiello Lecture delivered by the author at the Federation of Paint & Varnish Production Clubs Convention in Atlantic City in 1953. (CPVM-24)

**38.1.17.** A surface coating mastic composition comprising mixture of aggregate filler material and a vehicle comprising about 25 parts by weight of vinyl acetate-vinyl chloride copolymer dissolved in about 100 parts by weight of a solvent comprising about 70 per cent by weight of a liquid aromatic hydrocarbon and about 30 per cent by weight of a ketone, and a solution containing about 1/3 water and about 2/3 of an aliphatic alcohol having less than 4 carbon atoms in an amount sufficient to cause a two-phase separation of said mixture to produce a plastic cohesive phase of such non-sticky character that it can be spread with a trowel. (USP-141)

cf: 21.1.7

### Interior Wall Paint

**38.2.1.** Emmerling, et al, compared various interior wall paints. This is a continuation of earlier work. Results indicate that improved alkyd modified latex paints are much better in sheen uniformity than the other latex paints. These materials would be at least as satisfactory for single coat work as any other materials tested in any application for which they have sufficient hiding.

The commercial alkyd flat enamels differed among themselves significantly in ease of soil removal and degree of polishing but have a much higher sum of all washability ratings.

The selection of a product will depend largely on the objectives involved and the surface to be covered. The wide selection of interior coatings now available, enables the consumer to pick the product best suited for his particular problem. (OD-10)

**38.2.2.** Stieg & Burns discuss the effect of pigmentation on modern flat wall paints. Modern flat wall paints are expected to combine high hiding, non-penetrating, suitability for tinting to deep tones & washability with the enamel holdout of a primer-sealer and do so in a single coat.

It is impossible to formulate a flat wall paint having good color uniformity unless the vehicle used is completely non-penetrating. The penetration of a paint depends on the degree of agglomeration of the polymer molecules in addition to the size of these molecules. The degree of agglomeration is influenced by the type of solvent, the weaker solvents producing larger micelles.

The penetration of the paint is also determined by its P.V.C.

Better non-penetration, enamel hold-out and color uniformity properties are obtained where the P.V.C. is below the Critical P.V.C. for the pigment.

Formulation procedures have been suggested which if followed with available pigments and vehicles, will either result in the development of highly satisfactory flat wall paints or clearly demonstrate the unsuitability of the particular materials selected. (OD-26)

**38.2.3.** The Baltimore Club presents a comparison of alkyd flat, latex, and other interior wall paints. Stability tests, application characteristics, appearance of dried film, recoating and adhesion, washability, and summary and conclusion are presented. (POCR-7)

**38.2.4.** Singer presents part I of Chapter XI in "Fundamentals of Paint, Varnish & Lacquer Technology." This chapter deals with interior architectural finishes. (APJ-52)

**38.2.5.** Singer presents part II of Chapter XI in "Fundamentals of Paint, Varnish & Lacquer Technology." This Chapter deals with interior architectural finishes. (APJ-55)

**38.2.6.** Singer presents part III of Chapter XI in "Fundamentals of Paint, Varnish & Lacquer Technology." This chapter deals with interior architectural finishes. (APJ-57)

**38.2.7.** Singer presents part IV of Chapter XI in "Fundamentals of Paint, Varnish & Lacquer Technology." This chapter deals with interior architectural finishes. (APJ-59)

**38.2.8.** Stieg & Burns discuss how pigmentation affects flat wall paints. Effects of size, effects of PVC and penetration on brightness of color, effects of various vehicles on flat wall properties, and effects of pigmentation on flat wall paint properties are discussed. (CPVM-35)

### Exterior House Paint

**38.3.1.** Vannoy reviews pigments for house paints. The following are covered: historical, primer or first coat compositions, high hiding paints, fewer coats, lead free paints, calcium carbonate as an extender and future developments. (PVP-9)

**38.3.2.** Browne discusses clear finishes for exteriors of houses. Until the last 15 years or so, varnish or other clear, unpigmented protective finish was seldom used on major exterior wood surfaces of houses that were fully exposed to the weather.

In recent years a demand has arisen for clear finishes on major exterior surfaces of houses, particularly siding, primarily due to a desire to retain the attractive red color of some woods (as redwood or red cedar) or interesting patterns of knots, etc. Natural finishes are far less durable and require a great deal more maintenance than good house paint or shingle stain. (APJ-47)

**38.3.3.** Singer presents Chapter XII of "Fundamentals of Paint, Varnish & Lacquer Technology." This chapter deals with exterior finishes for houses and buildings. (APJ-65)

cf: 23.4.1

### Fire-Retardant Coatings

**38.4.1.** In a round table discussion presented at the Federation's 31st Annual Meeting in Atlantic City, October 31, 1953, fire retardant paints were discussed.

The panel was under the Chairmanship of M. W. Westgate and panel members were A. O. Allen, G. S. Cook, R. Craig, W. Cranmer, I. Messer, B. J. Tyler, A. Van Heuckeroth and M. Van Loo. (OD-20)

**38.4.2.** A fire retardant, washable intumescent coating composition of the character described including a reacted aminoplast-aldehyde resin selected from the group consisting of urea-formaldehyde resin and melamine formaldehyde resin, an amido compound selected from the group consisting of melamine and dicyandiamide, and a carbohydrate as the active ingredients, the said active ingredients being approximately in the relative ratio of 1:2:1 respectively, and said active ingredients carried in a solvent. (USP-18)

**38.4.3.** A potentially intumescing fire retardant coating composition comprising (1) from 15 to 85% by weight of solids, said solids comprising from 50 to 90% by weight of (A) a mixture containing from 10 to 100% by weight of a film-forming condensation product of 4,4′ dihydroxy diphenyl dimethyl methane with epichlorohydrin and up to 90% by weight of a thermosetting resin selected from the group consisting of (*a*) heat-convertible phenol-formaldehyde resins, (b) heat-convertible resins of an aldehyde and a compound selected from the group consisting of urea, thiourea, guanidine, cyanamide, dicyandiamide and amino-triazines having at least two amino groups and (*c*) alkylated derivatives of the heat-convertible resins defined in (*b*), and (*B*) a water-insoluble reaction product of phosphoryl chloride and anhydrous ammonia, said last named reaction product and said mixture being present in said solids in a weight ratio of 1:1 to 1:5; and (2) from 85 to 15% by weight of an organic vehicle which includes an organic solvent for said first named condensation product and said thermosetting resin, said reaction product of phosphoryl chloride and anhydrous ammonia having a nitrogen-phosphorus atomic ratio within the range of 1.5:1 to 2.0:1. (USP-115)

**38.4.4.** 1. A paint-like flame-retarding coating composition which comprises in an aqueous medium formaldehyde, urea, in amount by weight equal to from 100% to 300% of the formaldehyde content of the composition, a member of a flame-retarding group consisting of the ammonium and zinc salts of the orthophosphates and borates in amount by weight equal to from 200% to 400% of the urea content, a thickening agent stable in 0.1% to 5.0% of the total mixture, a finely divided inert, inorganic, solid in amount by weight equal to from 50% to 150% of the urea content and hexamethylene tetramine in amount by weight equal to from 5% to 50% of the formaldehyde content of the composition.

2. The composition of claim 1 in which the thickening agent is carboxy methyl cellulose. (USP-125)

### Coatings For Masonry

**38.5.1.** Wallon outlines the characteristics of the various concrete paints and how they should be used. In the selection of a paint

the following four criteria should be considered:

1. The degree of surface alkalinity
2. The degree of humidity
3. The results expected from the paint
4. The duration of the period during which the protection afforded by the paint is required to be effective.

(CPVM-12)

**38.5.2.** Schleicher discusses the protection of masonry. Masonry is subject to leakage, efflorescence, spalling and extremes of dirt collection. Since most masonry faults can be traced to water, protection against water is the prime objective in masonry protection.

The major types of water repellents used are:

1. wax types
2. stearates
3. solvent system silicones
4. water system silicones
5. emulsion types

(PIM-17)

**38.5.3.** Schleicher presents part II of his series of articles on masonry protective finishes. In this part the author discusses resin emulsions, cement paints, natural rubber and synthetic rubber paints. (PIM-21)

## CHAPTER 39

# INDUSTRIAL COATINGS

### General

**39.1.1.** Winter describes the formulation of butyl titanate paints with leafing pigments and some non-leafing pigments. The zinc dust formulation has been further improved. Butyl titanate paints have been tested as heat-resisting coatings on chimney stacks, car mufflers, locomotive fire doors and kerosene heaters, and as protective coatings for steel against corrosion by sea water. Some preliminary work on the preparation of butyl titanate anti-fouling paints is also described. (JOCCA-15)

**39.1.2.** Cowling, King & Alexander report on a study of temperature-indicating paints. Hundreds of compounds of interest to this application exist. A number of compounds are listed which when incorporated into properly working formulations will provide a series of temperature-indicating coatings covering the range from 50° to 116°C. fairly completely. (EC-8)

**39.1.3.** Nace & Walker studied the loss of drying on aging of lithographic varnishes containing alumina hydrate lakes. These studies showed that the loss increases with increasing acidity and moisture content of the pigments. It is also severe in the presence of Turkey-red oil and lakes containing excessive dye. The experimental data indicate that this loss is due to the adsorption of the cobalt onto the pigments. A cobalt adsorption test has been developed to distinguish those alumina hydrate lakes which are liable to produce loss of drying on aging. (IEC-52)

**39.1.4.** Hoenel describes a new type of baking finish wherein the solvent is water. Upon the proper addition of ammonia to the hardening and plasticizing components they became water soluble. This water solution after being applied and baked forms a hard glossy film. The coating material can be pigmented to yield colored finishes. The author feels that this type of coating material should offer many interesting possibilities which should be investigated more fully. (PVP-15)

**39.1.5.** Zuccari reports on the 31st Milan Fair. The Milan Fair inaugurated by Minister Campilli, attained exceptional importance due to large number of exhibitors and samples in an area of 390,000 square meters. Paints and materials exhibited included anti-rust paint, Araldit resins, fire-resisting paints which act as such because they are fire-resistant in themselves rather than fire-proofing the wood underneath. (PM-3)

**39.1.6.** Varron describes the mechanism whereby inks dry. The principal processes are absorption, evaporation, precipitation, solidification, filtration, gelation, oxidation, polymerization and thermal polymerization. However, although one method may predominate in the drying of one type of ink, most inks dry by a combination of processes. (PM-24)

**39.1.7.** Soane reviews aniline inks—volatile inks applied from a rubber stereo. He reviews the printing process using these materials, their formulation and the difficulties to be overcome, and methods of manufacture and testing. (PM-36)

**39.1.8.** Hopf reviews the history of printing inks for the electronic industry as applied to printed circuitry. He outlines the requirements of a suitable ink (such as be free from sulphur and chlorine, must contain only silver or silver oxide, flux and binders & solvents which completely volatilize or burn off at temperatures below 500°C) and the possible uses of the technique. (PM-47)

**39.1.9.** An investigation begun in 1951 at the Aeronautical Materials Laboratory, Naval Air Experimental Station, Philadelphia Naval Base, to find the reason for the corrosion of the metal paints of helicopter blades stored in closed, painted, wooden crate showed that acidic decomposition products evolved by paints while drying cause corrosion. This was true when the paint dried by oxidation or polymerization while the short-drying lacquer type coatings did not cause this corrosion. (C-1)

**39.1.10.** In many industries, the problem often arises of effectively painting and rust-proofing metal apparatus and structures under conditions of high humidity. Many suggestions have been made as to materials and methods in such cases.

A report of German work in this field reviews the use of emulsions & use of oil paints. Also included are water-soluble components, water-binding pigments, and water-binding varnish compositions. (PM-54)

**39.1.11.** Kienle & Maresh discuss some observations on optical properties of pigmented films. Color is a primary property of protective coating films, attained by the introduction of pigments or dyes into the vehicles used to form the films. The color of a pigmented film may vary according to the character of the light and the angle at which it is viewed.

Color is attained through selective scattering, selective absorption, or interference of light. The protective coatings industry attains color mainly through the use of light scattering or absorption phenomena or a combination thereof. The optical properties of pigmented films are combinations of body color and surface reflectance phenomena.

Body color of pigmented films, such as hue, chroma, masstone, tinting strength, and hiding power are dependent largely on the theories of physical optics. Factors influencing body color are chemical constitution, crystal form, particle shape, particle size, and dispersion of pigments. (OD-21)

**39.1.12.** Marling presents recommended finish formulations and application procedures for eight major classes of industrial products. These include finishing systems for:

1) Automobiles & Trucks
2) Air Compressors, Construction Equipment, Cranes, Hoists, and Fork Lift Trucks
3) Farm Equipment, Packaging Machinery, and Hardware
4) Machine Tools and Castings
5) Refrigerators, Vacuum Cleaners, and Other Household Appliances
6) Office Equipment and Furniture, Business Machines, Printing Presses, Recorders, Photographic Equipment TV and Radio Cabinets, Cash Registers, Food Mixers, Fans, and Similar Products
7) Stoves, Furnaces, Motors, Laboratory Ovens, Exhaust Pipes, Brake Drums, Motor Housings, Motor Cycle Cylinders, Sun Lamps, Radiator Covers, Gasoline Pumps
8) Chemical Equipment, Hydraulic Pumps, Oil Drilling Equipment, Textile Machinery, Dispensing Machines, Oil Tanks, Marine Winches, Refinery Equipment, Gasoline Pumps, Welding Equipment.

PE-3)

**39.1.13.** Starr discusses finishes using leather as an ingredient. Considerable interest has recently been focused on a process whereby leather dust (scrap from buffing or sanding leather) can be used at a relatively low cost to produce leather-type finishes having all the desirable adhesive qualities of organic coatings. (OF-29)

**39.1.14.** Ames reviews the progress in organic finishes during 1948-1953. In the last five years, a number of conditions—some transient, some permanent—have arisen, which have placed new demands on manufacturers of wood, metal and plastic products. A number of these are cited, as for instance:

a. shortage of copper, brass, nickel and chromium for civilian use—created by Korean War.
b. continuing trends in industry —as applications of coatings inair craft industry create new problems
c. radar installations and other electronic equipment used by the Armed Services frequently require protection against fungus growth. A glance at the future reveals more problems to solve. (IF-6)

**39.1.15.** Fuller discusses ten years of progress in industrial finishes. He reviews better furniture finishes, improvement of catalyzed synthetic varnish, metal loatings, better hiding and longer casting colors without bleeding, new types of resinous binders or vehicles, new resistant enamels, fast drying durability, acrylic and silicone resins, epoxy resins, durable baked coatings, hammered metal finishes, coatings for molded plastics, and new additions make more materials controllable. (IF-7)

**39.1.16.** Glaser presents lecture XII in the Third Ten-Year Practical Paint Course" sponsored by the New England Production Club, on "Industrial Finishes—Present Status and Future Prospects." Industrial finishes are traced back to the pitch used for waterproofing ships in Asia Minor as early as 4000 B.C. Question and Answer period followed the lecture. (APJ-5)

**39.1.17.** Wiesel presents lecture XIII in the Third Ten-Year Practical Paint Course, sponsored by the New England Production Club, on "Modern Lacquer in our Economy." A lacquer is defined as a coating composition which dries primarily through evaporation as compared to the drying by oxidation of varnishes and synthetic coatings. (APJ-7)

**39.1.18.** Singer presents part I of Chapter X of Fundamentals of Paint, Varnish and Lacquer Technology. This chapter discusses the clear oleoresinous finish. (APJ-35)

**39.1.19.** Singer presents part II of Chapter X of "Fundamentals of Paint, Varnish and Lacquer Technology". This chapter discusses the clear oleoresinous finish. (APJ-43)

**39.1.20.** Singer presents part III of Chapter X of "Fundamentals of Paint, Varnish and Lacquer Technology". This chapter discusses the clear oleoresinous finish. (APJ-44)

**39.1.21.** Miller reviews clear and pigmented lacquers. This first part reviews cellulose nitrate, ethyl cellulose, cellulose acetate, cellulose acetate butyrate, vinyls, acrylics, soluble nylon, polyamide resins, corn protein, parlon, styrene-butadiene resins, styrenated alkyds (and other alkyd copolymers), emulsion coatings, polystyrene, fluorinated resin (Exon 400-XR-61), and allylstarch. (POCR-28)

**39.1.22.** Miller reviews clear and pigmented lacquers. This second part reviews pigmentation, solvents—changes due to methods of application, wood finishes, nonyellowing lacquers, hot spray lacquers, automotive lacquers, metal lacquers, paper coatings, latex type coatings, textile printing lacquers, electrical cable coatings, heat resistant lacquers, multicolor lacquers, aerosol lacquers, stripping lacquers and conclusions, 24 references cited. (POCR-29)

**39.1.23.** Moore reviews industrial finishes. Industrial finishes can be classified under one of the following groups: (1) crystallizing finishes, (2) crackle lacquers, (3) hammer finishes, (4) wrinkle finishes, and (5) spatter finishes.

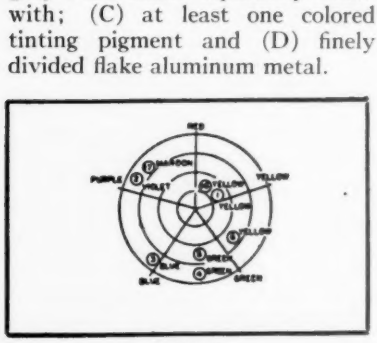
The author discusses curing of hammer finishes, curing of wrinkle finishes, ingredients and manufacture of wrinkle finishes, and desirable characteristics in wrinkles. An extensive bibliography is included. (APJ-68)

**39.1.24.** The first of two parts of a paper in the series "Technology of the Paint, Varnish and Lacquer Industry" covers cellulosic and chlorinated rubber lacquers. This series of papers was presented at the 1953-1954 Technology Course of the Toronto Paint & Varnish Production Club. (CPVM-26)

**39.1.25.** Wirt presents part II of "What you should know about cellulosic and chlorinated rubber lacquers." This series of papers was presented at the 1953-54 Technology Course of the Toronto Paint & Varnish Production Club. (CPVM-30)

**39.1.26.** A coating composition adapted to yield a tough, durable finish having a metallic appearance of great depth and brilliance comprising a vehicle and pigment, the said pigment consisting of a prime pigment selected from material of the group consisting of colloidal hydrous iron oxide and chromium tetrahydroxide; B *transparent* pigment substantially complementary in color to the said prime pigment in amount to yield a gray when mixed separately therewith; C at least one colored tinting pigment and D finely divided flake aluminum metal. (USP-1)

**39.1.27.** A coating composition adapted to yield a tough, durable finish having a metallic appearance of great depth and brilliance, comprising a vehicle and pigment, said pigment consisting of (A) the nickel complex of the azo dye obtained by coupling diazotized parachloraniline with 2,4-dihydroxyquinoline; (B) pigment substantially complementary in color to the said (A) pigment in amount to yield a gray when mixed separately therewith; (C) at least one colored tinting pigment and (D) finely divided flake aluminum metal.




(USP-2)

**39.1.28.** A lacquer composition comprising a resinous ingredient, and oxidation inhibitor capable of terminating the oxidation of said resinous ingredient when exposed to atmospheric oxygen, and a solvent for said resinous and inhibitor ingredients, said resinous ingredient comprising the product formed by oxidation of a mixture of unsaturated conjunct polymer hydrocarbons recovered from an acid-acting catalyst-hydrocarbon complex formed in the catalytic conjunct polymerization of hydrocarbons and consisting of polyolefinic, cyclic hydrocarbons boiling in the range of from about 150° to about 450° C. and having bromine numbers above about 140 and maleic anhydride values of from about 30 to about 90 and containing from about 2.5 to about 4 double bonds per molecule of which from about 40 to about 70% are in conjugated relationship to each other. (USP-17)

**39.1.29.** The method of making a protective coating material which comprises heating from 65% to 40% of a China-wood oil and from 35% to 60% of polyterpene resin to a temperature between 230° C. and 245° C. to form a varnish; thinning said varnish with a suitable solvent; and thereafter mixing from 35% to 85% of said thinned varnish, based on the non-volatile weight, with a material comprising from 20% to 90% mica and the balance titanium dioxide. (USP-23)

**39.1.30.** A liquid coating composition for application to the surfaces of plastic materials, said composition being characterized by the fact that it becomes bonded to plastic materials without heat and pressure and is resistant to molding treatment, including heat, said composition comprising the following materials in substantially the proportions indicated: 20 pounds pigment, 2½ fluid ounces wetting agent, 3½ to 6 gallons acrylic resin, 50 fluid ounces dibutyl oxalate and 80 fluid ounces to 1 gallon butyl lactate, said resin being selected from the group consisting of polymerized methylacrylate and polymethyl-methacrylate. (USP-28)

**39.1.31.** In the application of coatings of solutions in water of at least 2% concentration of protein having a pH at which the protein will remain in solution at room temperature which protein solutions contain therein in suspension silver halide particles, to a support therefor, the method of quick setting those coatings which comprises incorporating in the protein solution containing the silver halide in suspension therein ¼-50% (based on the weight of the protein) of an aldehyde selected from the group consisting of formaldehyde, glyoxal and acrolein, coating out the protein composition in fluid form onto the support and fuming the coating with gaseous ammonia whereby rapid setting of the coating is obtained without chilling thereof being necessary. (USP-30)

**39.1.32.** Process which comprises applying a cellulose nitrate undercoating to the surface of an article, coating said article with a gel lacquer comprising from about 15 to 40 parts by weight of cellulose propionate in about 100 parts by weight of a solvent mixture in which the solvents consist of from about 50 to 10% by weight of a material of the group consisting of propyl acetate, isopropyl acetate, butyl acetate and amyl acetate and from about 50 to 90% by weight of a material of the group consisting of xylol and toluol, and gelling the coating so produced by reducing its temperature below the gelation temperature. (USP-31)

**39.1.33.** A process of coating a water insoluble, water repellent coating upon the surface of a base material, comprising, applying an aqueous solution of a water soluble salt of an acid selected from the group consisting of starch ether carboxylic acid and starch ester carboxylic acid to said surface of said base and thereafter coating the so treated base with an aqueous solution of a polyvalent metal salt selected from the group consisting of water soluble salts of aluminum, ferric iron, chromic chromium, and tin, and forming a water insoluble salt with the acid applied in the first coating, said metal salt solution having emulsified therein a water repellent paraffin material. (USP-48)

**39.1.34.** A coating composition comprising a drying vehicle and an effective amount up to about 2 per cent by weight of metal, based on the weight of the drying vehicle solids, of a drier comprising a polyvalent drier metal salt of the monoalkylesters of diisobutenyl-

succinic acid and triisobutenylsuccinic acid, wherein the alkyl group contains from 1 to 4 carbon atoms, inclusive. (USP-54)

**39.1.35.** A polychromatic coating composition comprising an organic film-forming material, a colored pigment, and an aluminum flake pigment, said aluminum flake pigment constituting not more than 90% of the total pigment and having a covering area between 14,500 and 17,000 square centimeters per gram of flakes, not more than 20% of said covering area being contributed by flakes having a maximum dimension less than 5 microns and not more than 5% of said covering area being contributed by flakes having a maximum dimension greater than 25 microns. (USP-65)

**39.1.36.** A fluid resin dispersion, capable of being spread upon a surface and thereafter fused by heating into a hard, stable, continuous, tough and abrasion-resistant coating, comprising resin, plasticizer and diluent, said resin, plasticizer and diluent consisting of (1) solid thermoplastic polyvinyl resin having an average molecular weight in excess of 45,000 and made from vinyl chloride in major amount, (2) plasticizer for the said resin, and (3) diluent selected from the group consisting of the alkyl ethers of mono and diethylene glycol in which the alkyl radical possesses at least 4 but no more than 10 carbon atoms and having a boiling point above at least 205° C., in which the combined weight of the said plasticizer and diluent is from 33 to 40 per cent of the combined weight of said resin, plasticizer and diluent, and wherein the weight of said diluent is 15 to 85 per cent of the combined weight of said diluent and plasticizer. (USP-87)

**39.1.37.** A coating composition comprising 100 parts of an oily siccative diolefin polymer prepared by the polymerization of conjugated diolefins having from 4 to 6 carbon atoms in the presence of a catalyst chosen from the class consisting of hydrocarbon soluble peroxides and metallic sodium having a molecular weight between 1,000 and 10,000 in solution in a hydrocarbon solvent boiling between about 60 and 250° C., 5 to 300 parts of a finely divided pigment dispersed therein, a small amount of at least one heavy metal soap drier, and about 2.5 to 10 percent of powdered calcium oxide based on the weight of diolefin polymer. (USP-93)

**39.1.38.** A liquid coating composition capable of providing a smooth metallic surface on drying and burnishing comprising in admixture a synthetic resin consisting of a tripolymer of vinyl chloride, vinyl acetate and maleic acid; finely divided, unpolished aluminum powder consisting of particles of aluminum coming within the size range from about 1 micron to about 44 microns; an aliphatic ketone base solvent for the resin and a relatively small amount of propylene oxide. (USP-113)

**39.1.39.** A coating composition comprising a paraffin wax and a completely esterified styrene-maleic anhydride heteropolymer made by reacting the heteropolymer with a mixture of alcohols obtained by hydrogenation of coconut oil, said wax being present to the extent of from 70 to 99.90 per cent by weight of the total weight of the wax and the esterified styrene-maleic anhydride heteropolymer. (USP-118)

**39.1.40.** Process for the production of waterproof products which comprises mixing a liquid polymer of an organo silicone wherein each organo group is a methyl radical with silicon dioxide, the latter being in the form of an empalpable powder and forming at least 25% by weight of the mixture, storing the mixture for a period of at least one week at room temperature and thereafter working the mixture until it is converted at least to the consistency of a smooth paste. (USP-123)

**39.1.41.** A cement waterproofing composition comprising a 1 to 10 compatible, cold-blendable mixture of non-interacted ingredients comprising (1) an organopolysiloxane resin in which the organic groups are selected from the class consisting of methyl, ethyl, phenyl radicals, and mixtures of such radicals attached to silicon by carbon-silicon linkages and obtained by hydrolyzing an organochlorosilane designed to give the above-mentioned organopolysiloxane with a mixture of ingredients consisting essentially of (*a*) water and (*b*) a liquid chlorinated hydrocarbon which is a solvent for both the organochlorosilane and the formed organopolysiloxane, said solvent having a specific gravity above 1.1 and a boiling point below 175° C. and being inert to any formed hydrogen chloride, to the aforesaid organochlorosilane an to the organopolysiloxane, and (2) an oil-modified alkyd resin, the said organopolysiloxane resin comprising, by weight, from 10 to 50 per cent of the total weight of the latter and the oil-modified alkyd resin. (USP-126)

**39.1.42.** A coating composition of improved stability that forms water-repellent coatings of superior permanency, comprising a siloxanol whose molecules consist of silicon atoms to which are attached (1) OH groups, (2) oxygen linkages connecting silicon atoms, and (3) secondary amyl radicals, any additional radicals attached to the silicon atoms being (4) primary alkyl radicals having from one to six carbon atoms, the average number of the radicals (4) attached to each silicon atom being from 0 to 0.9, the average number of the radicals (3) attached to each silicon atom being from 0.3 to 0.75, the average total number of the radicals (3) and (4) attached to each silicon atom being not greater than 1.2, and not less than 30 per cent of said silicon atoms having the radicals (3) attached thereto. (USP-127)

**39.1.43.** A composition for forming temporary strippable protective coatings on finished surfaces, comprising a plasticized polyvinyl butyral dispersed in water containing as dispersing agents mahogany sulfonates corresponding to the formula $CnH_{2n-10}SO_3Na$, wherein $n$ is in the range of 20-30 and the average molecular weight is in the range of 400-600, said composition having a substantially neutral reaction and containing 2-16.5 parts of a stripping agent selected from the group consisting of soya lecithin and solid polyoxyethylene glycol, for 100 parts of the polyvinyl butyral. (USP-133)

**39.1.44.** The method of preparing coating compositions which comprises mixing together an aqueous solution of a water-soluble organic dye, and aqueous dispersions of a drying oil and dewaxed shellac, adding an electrolyte to

break the dispersions and transfer the dye and dispersed materials from the water to the oil phase, separating the water and drying the oil phase. (USP-135)

**39.1.45.** A coating composition comprising an organic film-forming material, which dries to a tough, durable, water-resistant film, and a pigment consisting of colloidal nickelous hydroxide, said nickelous hydroxide having been retained in a gelatinous water-wet state during the entire period between its formation and its incorporation in the said coating composition. (USP-151)

**39.1.46.** An aerosol lacquer of the pressure-generating solvent type containing 20-30% lacquer and a complement of a pressure-generating solvent consisting of about 50% dichlorodifluoromethane and a complement of 1,1,1-trichloromonofluoroethane, said lacquer consisting of 10-25% solids and a complement of lacquer solvent, said solids consisting of about 50% ethyl cellulose having a D. S. in the range of 2.5-2.6 and a complement of ethyl cellulose compatible plasticizing resins, and said lacquer solvent consisting of about 80% xylene and about 20% isopropyl alcohol. (USP-154)

**39.1.47.** Sherwin-Williams introduced Opal-Glo, a new approach in use of aluminum powder and colored pigments to give illusion of depth. A special technique is necessary. Its brush applied, then rolled to smooth it and to orient the metal flakes. Instead of seeking to get the metal particles to lie flat and give a plating-like effect, Opal-Glo keeps them on edge. The result is a certain degree of internal reflection that gives the effect of depth.

cf: 5.2.1
21.1.4
21.1.8
42.1.11
46.2.6

### Primers And Sealers

**39.2.1.** Rosenbloom presents data that help construct a picture of the reactions that occur between wash primer constituents. Oxidation plays a dominant part. Chromate derived from the pigment is soluble in the alcoholic phosphoric acid solvent and is the source of the oxidizing power of the composition. Phosphoric acid reacts with polyvinyl butyral but only under the influence of the reduction of chromium. (IEC-22)

**39.2.2.** Rigg & Skerrey report on 3½ years exposure of eight alloy specimens in rural, industrial and marine atmospheres, with various primers under aluminum topcoats. The results confirmed earlier indications. Zinc chromate and zinc tetroxychromate primers were superior in protective value to iron oxide primer, although the latter provided satisfactory protection, especially to aluminum in the less severe environments. Red lead primer was definitely harmful on light alloys, and especially on magnesium in corrosive environments. In these tests both types of chromate primer were found to be slightly preferable to red lead on mild steel. Zinc chromate and zinc tetroxychromate pigments are preferred for primers for composite structures of steel and light alloys in severe exposure conditions, while iron oxide is adequate for milder conditions. (PM-34)

**39.2.3.** Testro discusses primer failures on exterior woodwork. From a purely adhesion standpoint the absorptive nature of wood would seem to make it an ideal receptive surface for painting systems. This article outlines some of the reasons for the failure of primers. Moisture in the wood is one of the prime factors affecting failure-some moisture is necessary in the wood as excessive dryness leads to failure as does excessive moisture in the wood. Other factors include differences in grain structure, sea salt contamination in some woods, non-uniformness in the expansion and contraction of wood in different direction, resinous content of the wood, and extraneous matter on the surface of the wood. (PM-44)

**39.2.4.** Results of tests on pretreatment primers is presented. The primers referred to are based on polyvinyl butyral as the film-forming resin and a particular form of yellow zinc chromate, zinc tetrahydroxy chromate, as the pigment. The solvent carrier consists of a blended mixture of solvents (mainly alcohols) containing a specified quantity of water and phosphoric acid. The performance of these etch primers under hot damp conditions is established as very good. (PF-8)

**39.2.5.** Danforth, et al, discuss the protectometer and the evaluation of anti-corrosive primers. Three classes of methods are used for evaluating metal protective coatings:

1. preliminary or screening tests
2. panel exposure tests
3. field tests.

The salt spray test is one form of laboratory test which can be used for preliminary or screening testing. The use of the protectometer utilizing an electrochemical technique eliminates the human element in evaluating salt spray tests. Wiring and external circuit diagrams are presented. (POCR-5)

**39.2.6.** An aqueous softening and sizing medium suitable for application to gel films of regenerated cellulose, said medium comprising 5% glycerol, 0.1% colloidal silica, and 0.1% of a condensate of stearic acid with ethylene oxide containing 50 ethylene oxide units per molecule. (USP-56)

**39.2.7.** As a coating composition for wood, a solution-suspension containing the following constituents by weight: 372 parts butanol; 685 parts of a mixture consisting of 50% refined shellac and 50% alcohol; 30 parts of a mixture comprising 50% manila gum and 50% butanol; 2100 parts silica; and 870 parts talc. (USP-108)

**39.2.8.** A storage-stable dry rosin size consisting essentially of the dry saponification product of rosin remaining after the removal of the fatty acids from tall oil by fractional distillation, said size containing about 0.5-2% of phenothiazine and about 0.2-2% of a diaryl-amine based on the weight of said rosin. (USP-132)

**39.2.9.** The Lead Industries Association has issued Red Lead Technical Letter #8: Primers for Railroad Structures and Rolling Stock.

cf: 39.3.4
50.4.1

### Metal-Protective Coatings

**39.3.1.** Slabaugh & Grotheer present a theory for the mechanism of filiform or underfilm corrosion. Observations show that filiform corrosion is an electrochemical process. The actual electropotential that exists between anodic and

cathodic areas was measured, and the identity of these areas was established. An osmotic phenomenon probably accompanies the electrochemical reactions. The growing head of the rust filament is a tiny corrosion cell that contains an anolyte of approximately 40% solids. The electrolyte in this cell originates in the corrosion reactions and in the diffusion of moisture through the film, where small quantities of soluble components are eluted.

The proposed theory provides a point of departure for the development of suitable means of controlling filiform corrosion. (IEC-55)

**39.3.2.** Recent German investigations into accelerated testing of anti-corrosive paints included the three different periods or stages in the life of an anti-rust paint film-pre-aging, properly aged, and decline. It was concluded that the accelerated test suffers two defects a) only the present, maybe temporary predominant factors are studied; b) artificial media and methods are often too vigorous. (PM-28)

**39.3.3.** Stauffacher & Davidson report on field tests of exterior coatings for a pipe line conveying fuel oil heated to 200°F. Four different coatings were tested-asphalt wrap with average total thickness of 0.250 inches, coal-tar wrap with average total thickness of 0.250 inches, coal-tar wrap with average total thickness of 0.156 inches and asphalt mastic with average total thickness of 0.500 inches. Due to its ruggedness and freedom from distortion during the test, it was decided to recommend a ½ inch thick asphalt mastic coating using a 250°F melting point asphalt for the hot-oil pipe line exterior coating. (C-2)

**39.3.4.** Danforth, et al, discuss the protectometer and the evaluation of anti-corrosive primers. There are three classes of methods used for the evaluation of metal protective coatings: 1) Preliminary or screening tests, 2) Panel exposure tests, and 3) Field tests. Group one tests can be conducted in the laboratory and are used to eliminate poor coatings and consequently reduce the number of exposure panels. Accelerated weathering, salt spray, water permeability, and water condensation are examples of this type of test.

The authors feel justified to conclude that the life of an anti-corrosive primer coat can be predicted from its behavior in the saltspray cabinet and the determination of the electrical resistance of the paint film at various intervals.

In the cases studies, the composition of the vehicle influenced the protective abilities of the paint, even at relatively thick coats of 4 mils thickness. The influence of the pigment volume concentration upon the resistance to corrosion proved to be pronounced if relatively thin coats (2 mils) were studied. The thickness of the coating is important in that much greater protection was provided by a film of 5 mils than by one of 3 and 1 mil thickness, respectively. (OD-15)

**39.3.5.** The use of the roller-coating machine to lacquer metal sheets, the conversion of the sheet into cans, and the different lacquers required for various purposes were recently described in a lecture to the Organic Finishing Group of the Institute of Metal Finishing by T. G. Green. Lacquering or decorating the outside is used to make the package pleasing in appearance and lacquering the inside prevents chemical action between the can and the contents. Thus the coating protects the metal against attack from contents by products of such action. (PM-38)

**39.3.6.** "The Protection of Ferrous Metals" was the title of an exhibition, the first of its type in the United Kingdom, organized recently by the Corrosion Group of the Society of Chemical Industry at Battersea Polytechnic, London. Of the four main methods of controlling corrosion, the use of protective coatings is by far the most important. (PM-39)

**39.3.7.** A number of papers, presented at the Fourth International Conference on Electrodeposition and Metal Finishing held in London recently, dealt with organic finishes for metals. These papers included Automobile Organic Finishing, Infra-red Stoving for Paint Finishes, A New Type of Primer for Resistance Welding, and Finishes on Electroplated Coatings. (PM-53)

**39.3.8.** Before the beginning of the 20th Century, most water-treatment equipment was constructed of masonry and hence was not excessively subject to corrosion. Modern water treatment requires the use of corrosive chemicals and equipment has been fabricated more and more of ferrous alloys which are subject to corrosion. Therefore a considerable corrosion problem is presented in many phases of water treatment, both in the prevention of the destruction of equipment and in the prevention of contamination of the water. Smith discusses some of the types of water treatments which are employed today and the corrosion prevention measures which are taken. (OF-5)

**39.3.9.** Smith presents the second part of his discussion of protective coatings and linings for water treating equipment. In this last part he covers: coatings for degasifier units, coatings used for filtration and coagulation equipment, coatings for chemical feeding equipment, and other applications for protective coatings in water technology. (OF-12)

**39.3.10.** Hedlund reviews recent developments in silicone vehicles for maintenance paints. Silicone resins have won wide recognition as vehicles for heat-stable and corrosion-resistant paints. Use of these finishes has been pretty much confined to heat-resistant applications, and their full value could not be realized on ordinary installations which could not be heated.

Certain new resins have been developed which show definite promise. These include silicone-alkyd resins and vehicles. (OF-13)

**39.3.11.** Larson discusses the development and use of polyvinyl butyral wash primers to control corrosion of metals. The metal conditioner or wash primer principle assures a better foundation for paint systems while preventing underfilm corrosion. Direct economies result from less frequent shutdowns for repairs and replacements in marine, industrial and maintenance fields. (OD-63)

**39.3.12.** Rabate & Rabate discuss the maintenance painting of the Eiffel Tower. The most widely used paint has been a linseed oil

paint based on micaceous iron oxide. (OD-64)

**39.3.13.** Grupp reviews the contents of the recently declassified Naval Research Laboratory's third report on experiments with anti-corrosive coatings for magnesium. A copy of the report is available from the Photoduplication Section, Library of Congress, Washington 25, D. C. (OF-22)

**39.3.14.** Stewart discusses impermeable organic coatings. The ideal corrosion resistant coating is one that, even though in a single layer, would not allow either liquid cr gas to be transmitted by or penetrate through its film. Almost perfect impermeability can be obtained with a plurality of coatings. (OF-24)

**39.3.15.** There are a number of reasons for applying an organic finish over electroplated surfaces. It affords outstanding contrast, as in name plates, it satisfies electrical requirements where electrical contrast has to be made to the base metal, and it utilizes raw material which is supplied in the electroplated condition. Organic finishes may be applied to almost every kind of electroplate, however zinc and cadmium offer the greatest practical difficulties. The organic finishes employed may be lacquer, enamel, paint or varnish, but the technical problems involved are much the same in each case. (OF-42)

**39.3.16.** After briefly mentioning the theory of metallic corrosion, Volkening relates the problems encountered by Dow in protecting its Gulf Coast plants against atmospheric corrosion. Examples of coating successes and failures are given. The method which Dow uses of testing paint cooperatively with the manufacturer is explained. The author points to advantages of proper surface preparation and suggests too little attention is paid to educating the 350,000 painters who apply coatings to metals in proper application techniques and that paint manufacturers, paint manufacturer's associations and the National Association of Corrosion Engineers might find the organization of schools for painters a worthwhile activity. (C-5)

**39.3.17.** The principles applying to the formulation of organic coatings are given and the effects of vehicle, pigments, and thinners are discussed. Special problems applicable to the preparation and application of plastic coatings are discussed with particular reference to their adhesion, solubility, and pigment dispersion characteristics. Plastic prefabricated liners, liquid coatings, dispersion resins, hot melt techniques and mastics are covered. The mechanism by which coatings retard corrosion are listed and the relative value of barrier and polarizing coatings mentioned. Coatings suitable for severely corrosive environments are considered and the special qualities of coatings suitable for use underground are listed. The questions of adhesion, permeability, surface preparation and chemical stability are correlated for coatings suitable for underground pipe or marine vessels. (C-6)

**39.3.18.** Greenblatt discusses sea water immersion trials of protective coatings. Trials of a variety of types of underwater compositions have shown the superior performance of vinyl finishes, both as protective and antifouling paints. Panel tests have shown that vinyl finishes can be used on cathodically protective hulls and shipboard trials have substantiated this, provided that a controlled cathodic protection system is used. (C-7)

**39.3.19.** Seymour believes liquid neoprene, among the coatings commercially available today, appears to be closest to the ideal coating. The characteristics of several compositions of neoprene are given, application and curing techniques discussed, resistance to certain chemicals itemized and conformity with military and industrial standards compared.

Superiority of Type KNR over certain other compounds of neoprene is discussed and explained. The author recommends on-the-job compounds as superior to one-part compounds. Specifications for various kinds of neoprene formulations are given, together with an explanation of fillers, applications and compounding techniques.

Numerous case histories of successful application of neoprene to protect plant against various corrosive environments are listed. (C-8)

**39.3.20.** Grove describes procedures and results of coating internally several miles of old aluminum, steel and new steel pipe. The method involves scraping corrosion products from inside old pipes, descaling and drying. Coating is applied when two plugs between which coating has been poured are moved through the pipe by air pressure. Drying by air injection or aspiration follows. Economics of the lining operation are reported to be good although perfect results were not obtained with badly corroded steel pipe. Adhesion of the coating is the critical problem, even small amounts of water being conducive to separation. Coating of new steel lines is facilitated by proper design. Rigid inspection at every phase of the cleaning, drying and coating operation is recommended, at least 5 mils thickness is recommended, this to be obtained by multiple coats, if necessary. When dessicants are used in drying operation some means of determining when the dessicant is saturated should be employed. Better cleaning is needed, especially to remove sulfides. (C-9)

**39.3.21.** Alkaline and hygroscopic welding flux byproducts deposited on weld seam and adjacent areas frequently are the cause of early failure of coatings on welds. Close observation, by Liebman, indicates many paint failures previously believed to have resulted from residual stresses in weld areas can be attributed to the effects of weld heat oxides, weld flux, spatter and weld flux fume deposits.

Extra thick vinyl pretreatment coatings followed by a mastic and finish coat are helpful in prolonging protection given metal from the environment when flux deposits are inadequately removed. (C-10)

**39.3.22.** Data received in reply to a questionnaire is compiled on the actual field practices of utilities operating pipe-type cables. The data cover more than 90 percent of this type of cable in operation at the time the survey was made. The principle data are tabulated, giving reports by seventeen operators on field practices. The subjects covered include size and kind of pipe, coating materials, holiday testing, potential surveys, cathodic protection, coating resistance mea-

surements, rates of coating resistance depreciation, bonding, stray current measurements, shunts, surveys, voltages and magnitudes of cathodic protection currents and other information. (C-13)

**39.3.23.** Blackmore discusses the use of protective coatings as the first line of defense against corrosion. Included are theory of corrosion, air conditions offer a special challenge, two ways to combat corrosion, why use a primer, discussion of adhesion, the importance of adequate care, and other functions of coatings. (IR-8)

**39.3.24.** Farber discusses a new epoxy primer having high resistance to alkalies. Its superiority over an alkyd primer is illustrated. A new flow coating technique combined with this new primer permits thinner film thickness and improves corrosion resistance three times. (MM-3)

**39.3.25.** Benn discusses the use of asphalt coatings—solvent and emulsion—for metal protection. Advantages are low initial cost of application and extremely long life of the material. Disadvantages is color which is offset to some extent by use of an asphalt-aluminum paint. (MM-5)

**39.3.26.** Marsh describes the use of organic finishes on electroplated surfaces. The most important reason for using the combination of electroplate and organic finish is to provide better resistance to corrosion than would be afforded by either finish when used alone. Other reasons for the choice of dual coatings are:

1. to give improved adhesion to the organic coating; for example, nickel on brass and phosphor bronze
2. to provide electrical insulation (enamel on electroplated cable supports)
3. to afford outstanding contrast, as in various types of name plates
4. to satisfy electrical requirements
5. to utilize raw material which is supplied in the electroplated condition (zinc coated steel sheet).

Some form of "chemical treatment" for electroplated coatings is desirable if the best characteristics of adhesion are to be developed in organic applied coatings. It is a must for zinc, cadmium, copper and chromium and advantageous for nickel, tin, silver and gold. For zinc and cadmium, practical processes in ascending order of merit are chromating, phosphatizing, tin plating and etch priming; and for the other metallic coatings, etch priming is the most effective treatment. (PF-13)

**39.3.27.** Van Loo, et al, discuss filiform corrosion. Filiform corrosion is a thread-like type of corrosion which develops under protective coatings on certain metals, usually in humid atmospheres. It has directional growth and definite structure. Controlling factors are the physical nature of the coating and the exposure conditions. The tracks do not cross each other but deflect or join in a predictable manner. A theoretical explanation is offered involving a driving force and a directing force. The driving force is the diffusion of the corrosive atmosphere into the active head resulting in further metallic corrosion. The directing force is explained on the basis of concentration cells. (POCR-12)

**39.3.28.** Pierce discusses two good reasons for going to thick protective coatings. Under 5 mils thickness, failure of equipment will be rapid regardless of coating type—due to poor coverage over hard-to-coat areas. Above 5 mils, coating performance can be controlled—and it depends primarily on resistance to the environment of the coating selected. (CE-15)

**39.3.29.** Liebman discusses corrosion resistant finishes. Finishes to protect metal against corrosive agents have been used by industry with more or less success for over one century. There is no paint formulation which would suit every possible situation and environment.

The author lists 19 characteristics of paints, and 14 methods of control. (APJ-66)

**39.3.30.** Thiede discusses corrosion prevention and control. No single paint will answer every purpose and for general painting purposes under the conditions present at the Grasselli, N. J. plant of General Aniline Works Division of General Aniline and Film Corp., a paint blended of oil and phenolic vehicles gives longer service life than straight applications of either the oil or phenolic types. (PIM-8)

**39.3.31.** Schleicher presents part II of his paper on protection of steel. This part covers the subject of primer coats and includes vehicles and pigments with discussions on red lead and blue lead. (PIM-27)

**39.3.32.** Honnaker reviews corrosion control and prevention. Types of corrosion are discussed. Plastics and elastomers, rubber-lining compounds, and protective coatings for control and prevention of corrosion are discussed. (PIM-28)

**39.3.33.** The method of forming an improved corrosion-resistant paint which comprises mixing turpentine and anhydrous antimony chloride, with the amount of antimony chloride being from 30% to about 50% by weight of the mixture, until an oily material containing an antimony compound is formed, adding water to the oily material containing said antimony compound, thereby forming a water-insoluble, colloid-like dispersion of an antimony compound in the oily material, and adding a neutralizing agent to the dispersion in order to neutralize any free acid. (USP-46)

**39.3.34.** An improved composition of matter for use as a protective coating for oxidizable metals consisting substantially of 2½% to 35% by weight sodium meta borate, up to 40% by weight plastic clay, and 15% to 90% by weight of an inorganic material of reduced valence, termed an oxidation inhibitor incapable of reacting with the said borate selected from the group consisting of graphite, carbon black, iron and copper, said percentage of sodium meta borate being based on the weight of the anhydrous salt. (USP-55)

**39.3.35.** A composition adapted for use as a rust-inhibiting coating for metals, comprising a substantially non-corrosive vehicle in major amount based on the weight of said composition, and a small amount, sufficient to impart rust-inhibiting characteristics to said composition, of a hydrocarbon acid phosphate salt of an alkylol-containing amine having an alkylol group esterified with a hydrocarbon sulfonic acid. (USP-75)

**39.3.36.** In a method of protecting metallic objects from corrosion, the steps of: applying to the sur-

face to be protected a coating composed essentially of an aqueous solution of alkali silicate and finely divided metallic zinc, the zinc constituting between about 75% and 96% of the mixture on a dry basis, and treating said coating with a dilute aqueous saline solution having a pH of between 4 and 8.5 to produce a complex zinc-alkalisilicate in situ. (USP-106)

**39.3.37.** An anti-corrosion coating composition comprising 100 to 102 parts of a copolymer of vinyl chloride, vinyl acetate and maleic acid wherein the vinyl chloride forms 86%, the vinyl acetate 13%, and the maleic acid 1% of the copolymer, 40 to 42 parts of a methacrylate polymer selected from the group consisting of n-butyl methacrylate polymer, isobutyl methacrylate polymer and n-propyl methacrylate polymer, 33 to 35 parts of a plasticizing material selected from the group consisting of the polyethylene glycol-di-2-ethylhexoates and tri-2-ethylhexyl-phosphate, and 5 to 7 parts of zinc potassium basic chromate, all in a solution of low boiling solvents. (USP-119)

cf: 1.2.1
18.7.1
32.1.1
32.2.1
39.1.1
39.1.9
39.7.2

### Automotive Finishes

**39.4.1.** McMaster states that an automotive finish is applied with two purposes in mind; one is to protect metallic elements against corrosion; the other, to provide a pleasing appearance. These considerations naturally govern the tests used in evaluation. We do not care what a finish is made of so long as it does the job. All testing is done to performance specifications on the basis that a material under consideration must equal or better that in present use. When a choice must be made, it is desirable to have a factor of safety. Thus, if finish "A" will last ten years and finish "B" fifteen years, while the life of the automobile is ten years, either finish should be fully satisfactory. Such a choice is referred to as being made on the basis of "intrinsic worth" rather than on mere acceptability. (PM-6)

**39.4.2.** Makers of car and vehicle finishes are continually seeking to make their products more durable and more attractive and the modern car with its long-lasting paintwork testifies to their success over the last thirty years. Progress in car finish testing, including details of a new apparatus to simulate atmospheric conditions is reviewed. (PM-50)

**39.4.3.** A number of papers, presented at the National Passenger Car Body and Materials Meeting, Detroit, March 2-4, 1954 dealt with the finishing of automobiles. An abstract of these papers forms this article. The paper included:

Trends in New Automotive Finishes — R. B. Davis
Automotive Enamels — A. J. LaPointe
Lacquer as a Finish on Automobiles — R. J. Wirshing
Evaluation of Automobile Finishes — H. W. Redshaw
(OF-30)

cf: 42.1.13

### Furniture & Wood Finishes

**39.5.1.** Cellulose lacquers are the most commonly used finish in the European furniture industry, according to a report published by the Furniture Development Council (England). This report also points out the prevalence of spray finishing in some countries and indicates the drying problems experienced by some manufacturers. It was compiled from the answers to a questionnaire sent to organizations in Germany, Austria, Belgium, Finland, France, Great Britain, Holland, Italy and Norway. (PM-49)

**39.5.2.** Sanches discusses the basic considerations in wood finishing. There are four excellent economic reasons for finishing wood:

1. protects the wood
2. enhances the beauty of the wood
3. makes wood easy to clean
4. increases sales appeal

Steps and materials considered are sanding, staining, filler, sealer, lacquer coating, rubbing, and polishing. (OF-35)

**39.5.3.** Mansell describes finishing processes for steel furniture. The finishes vary with the service requirements. Included are the preparation of the metal surface, prime-coating operations, selection of finish coats after careful testing, the finishing of metal dinette furniture, typical burn-off system, a variation of the phosphate treatment, and the painting of outdoor metal furniture. (OF-40)

**39.5.4.** Hoge discusses the finishing of radio and TV cabinets by Wm. L. Hoge & Company. The finishing room is on two floor levels, the first being for production while the force drying is done on the balcony. (IF-15)

**39.5.5.** Bickel describes how he patches and repairs surface finishes. He describes the portable workshop which he uses for on the spot touch-up work, which includes such jobs as rubbing out fresh packing marks, lacquer stick build-up plus final finishing, highlighting, shading, Frenching Technique, scratch removal, etc. (IF-22)

**39.5.6.** Wyrwa describes the finishing of fine hardwood sewing machine cabinets at the White Sewing Machine Plant. This includes stain, dry, fill, pad in, lacquer sealer, then two coats of lacquer with drying following each one, then rubbing with portable air driven machines. (IF-25)

**39.5.7.** Amster describes the finishing of TV cabinets in France. (IF-29)

**39.5.8.** Cornwell describes the finishing of oak tables and mahoganized TV cabinets by Cornwell Co., Inc. Because the finishing operations on blond and "silver fox" coffee and occasional tables and on mahoganized TV cabinets are widely separated, their finishing room is located in two buildings and on two floors. (IF-38)

**39.5.9.** Neukam describes the finishing of fine office furniture by the Jasper Office Furniture Company. (IF-48)

**39.5.10.** A film-forming water-in-oil dispersion for treating wood surfaces consisting essentially of from 2.25 per cent to 7 per cent by weight of wax, from 1.25 per cent to 5 per cent by weight of dimethyl polysiloxane having a viscosity within a range of from 100 to 30,000 centistokes at 25° C., from 10 to 20 per cent by weight of water consisting of droplets coated with said wax and the major portion by weight of a liquid solvent having an aniline point within a range of

from —22° to 185° F., a distillation range within the limits of from 19 to 450° F., and selected from the group consisting of hydrocarbons, ethers, chlorosubstituted hydrocarbons and mixtures thereof. (U P-116)

cf: 6.1.1

### Putty & Caulking Compounds

**39.6.1.** In a round table discussion presented at the Federation's 31st Annual Meeting in Atlantic City, October 31, 1953, putty and caulking compounds were discussed.

Papers included:

Introduction-H. Kelfer
Research & Development-R. S. McCleary
Equipment-H. W. Hibbert
Putty and Caulking Failures, Causes and Prevention-G. E. Hann
Specifications-W. M. Lawall
(OD-19)

**39.6.2.** Kelfer presents lecture XIV in the Third Ten-Year Practical Paint Course sponsored by the New England Production Club, on putty and caulking compounds. Question and answer period followed the lecture. (APJ-9)

**39.6.3.** Hibbert discusses the achievement of good paint jobs through high grade caulking compounds. In discussing these compounds, the author covers pigments, oils, and volatile solvents, surface preparation, conditions under which the compounds are used, and metal and asphalt. (PIM-23)

cf: 50.4.1

### Heat Resistant Coatings

**39.7.1.** Owens, et al, studied vehicles and pigments in high heat resistant coatings. All of the heat resistant colors tested, showed promise up to 700°F. The precipitated iron oxide, both yellow and black, showed definite color change to red in the region above 500°F. The cadmium yellow turned reddish bronze from about 400°F. up, while undergoing heating; on cooling returned to its normal color. All of the heat resistant colors seemed to do no better, in general, than the silicone in which they were dispersed. All of the heat resistant colors except selenium red & cadmium yellow were also graded when sprayed over a coat of the standard formulation. The cadmium selenium red showed as good performance over the bare metal as over the standard formulation, while the cadmium yellow showed poorest performance over both surfaces.

Both the DC-805 and SR-52 silicones showed a definite improvement over DC-801 or SR-61 silicones. The butyl titanates did not rate as well as the silicones. All of the heat resistant colors tested rated no worse than the vehicle in which they were dispersed. The use of a properly pigmented undercoating extended the heat resistance range of all the colors except cadmium yellow.

The outstanding heat resistant colors were cadmium selenium red and chromium oxide green. (OD-11)

**39.7.2.** Grupp discusses butyl titanate heat and corrosion resistant paints. Methods for polymerization of butyl titanates are discussed as are other additives to the paints. Formulations are presented for:

Aluminum Paint
Black Paint
Copper Oxide Anti-Fouling Paint
Green Chromic Oxide Paint
Red Oxide Paint
White Paint
Zinc Dust Paint
(OF-43)

cf: 39.1.1
50.1.10

### Printing Inks

**39.8.1.** Bowles reviews the past 25 years of ink research. During this quarter of a century the ink industry has passed through a complete era, during which time other vehicles have supplemented the original Baltic linseed oil used exclusively for making litho varnishes for inks. The author discusses ink consistency or "body", color, drying, adhesion and related interfacial phenomena, new printing processes, Candide in the new technology, and the progress of science. (JOCCA-38)

**39.8.2.** This second and concluding part of Varron's article on how inks dry include the following methods—precipitation of the resin, solidification, filtration, gelation, polymerization by oxidation and thermal polymerization.

A generalized picture of the process can be drawn. Initially there is gross penetration of the ink into the stock. This is followed by the separation of a portion of the vehicle from the bulk of the ink which results in the partial setting of the ink. Complete setting of the ink occurs when a gel structure is formed. The final phase involves the solidification of this gel structure. (PM-31)

**39.8.3.** The way in which research helps with problems was the theme of an exhibition held recently by the Printing, Packaging and Allied Trades Research Association. The exhibits are described briefly in this article. (PM-64)

### Solvent Resistant Coatings

**39.9.1.** Cowling, et al, review organic coatings adaptable to fuel storage. A considerable advance has been made in the technology of coating concrete designed for the storage of fuels derived from petroleum. Also, much information applicable to fuel-resistant coatings for steel has been acquired. Polymer types now acceptable for these applications are limited to the more inert vinyl resins, polysulfide rubbers, and vinylidine chloride-acrylonitrile copolymers. Vinyl coatings properly formulated and plasticized possess the required inertness to resist solvent attack. Their use alone is limited by their lack of extensibility particularly after aging. This is a serious defect in applications to concrete.

Polysulfide rubbers, do not possess the high degree of inertness needed but do display good adhesion and extensibility.

A copolymer of vinylidine chloride-acrylonitrile is among the more fuel-inert materials adaptable to fuel tank living. It can be used alone on steel but on concrete it is best used as an overcoating for polysulfide rubber.

The most significant achievement has been the development of a fully satisfactory lining using the materials in aqueous dispersion. Thus a greater film thickness can be applied and the solvent hazards are eliminated. (IEC-86)

cf: 39.1.1

### Antifouling Paints

**39.10.** (No abstracts)

cf: 39.1.1
39.3.18

### Fungicidal Finishes

**39.11.** (No abstracts)

cf: 36.3.1
36.3.5
36.3.11

### Adhesives

**39.12.1.** Grinsfelder, et al, treat some elementary, but basic factors involved in evaluating potential structural adhesives generally, including specific data for adhesives tested on polymethacrylate adherents and suggest a new approach to the problem of minimizing destructive testing in inspection procedures on bonded assemblies. (ASTM-7)

**39.12.2.** Marra presents the first of a series of articles on adhesives. This first article covers wood-to-wood bonding and includes theory of adhesion, wood adhesives, equipment and processes, cost, standardization and what remains to be done in the wood adhesives field. (MP-6)

**39.12.3.** Epstein presents the second of a series of articles on adhesives. This second article covers metal-to-metal bonding and includes theory of adhesion, design considerations, coefficient of expansion, typical adhesives, new adhesives, polyurethane resins and what remains to be done in the metals adhesive field. (MP-9)

**39.12.4.** Moser presents the third and concluding article in the series on adhesives. This third part deals with the use of synthetic resin adhesives in meeting the demands of a difficult and highly specialized application: bonding glass to itself and to other materials. (MP-12)

**39.12.5.** McLaren presents a general theory of the adhesion of high polymers to cellulose. The theory includes a consideration of the influence of: melt viscosity and tack temperature of polymers, kinds and numbers of polar groups in polymers, plasticization, temperature and nature of the surface. With cellophane-polymer systems polarity and hydrogen bonding are of paramount importance in adhesion. (MP-30)

**39.12.6.** Elam discusses the use of epoxy resin-based adhesives to bond metal-to-metal. Bond characteristics, strength under static and impact loading, and application factors are presented. (PE-4)

### Coatings For Textiles

**39.13.1.** Pigment dyeing and printing gaining ground in Europe but is not expected to replace classical processes. Pigments may be applied to practically all types of fibers with possible exception of polyvinyl chloride, even those derived from glass, and therefore to all types of blends, without being affected by the nature of dyestuffs, swelling agents, and textile aids.

An anology may be drawn between pigment printing and dyeing and the crease-resisting treatments based on urea formaldehyde and melamine formaldehyde resins, as well as with silicone waterproofing processes. (CEN-16)

cf: 21.1.10

### Organosols & Plastisols

**39.14.1.** Field coils on cranking (starter) motors and the generators which keep the car battery charged are now being coated with vinyl plastisols, supplanting the former method of covering these coils with heat-sealing cloth. Advantages of the grey plastisol covering include high resistance to gasoline and other petroleum products, water, organic and mineral acids, and alkalis. Furthermore, the plastic material has excellent resistance to abrasion, good heat stability, and is flame resistant. (MP-1)

**39.14.2.** Powell, et al, discuss vinyl resin organosols; suspensions of very finely divided vinyl chloride type resins in organic liquids which are capable of dissolving them at room temperature. After application, a baking operation serves to drive off any volatiles and to fuse the resin particles together into a strong film.

The rapid growth in the commercial importance of the vinyl resin organosols has served to focus attention upon this method of preparing coatings. It is believed to have wide applicability to relatively insoluble thermoplastic resins.

The various commercial grades of organosol resins have been compared briefly, and some of the general principles of formulation of both organosols and plastisols have been discussed. A few of the experimental approaches to a study of the physical chemistry of organosol systems have been reviewed briefly. (OD-27)

**39.14.3.** A single coat of colored plastisol applied on continuous production line meets every physical and chemical requirement in protecting oil control valves. (MP-29)

**39.14.4.** The Scientific Oil Compounding Company, Inc. has issued 4-page technical bulletin describing fungus resistant vinyl plastisols.

**39.14.5.** "Bakelite Vinyl Dispersion Resins for Organosols & Plastisols" is the name of an 8-page booklet just published by Bakelite Co. Included are typical uses, properties methods of application.

cf: 3.1.6
20.1.4

### Electrical Insulation

**39.15.1.** Christensen reviews silicone dielectric materials. As electrical insulating materials, silicones offer four advantages. Their use permits 1) substantial reductions in space and weight, 2) longer service life, 3) reliability when exposed to temperature and moisture extremes, and 4) above-average mechanical and electrical abuse. These advantages stem from one property—heat resistance. (PE-2)

**39.15.2.** Ryan presents the results of a study to determine the effect of in-pile radiation on some representative insulating structures. There is a possible correlation between chemical composition and the ability to resist high-intensity radiation. Highly phenylated structures appear to be more radiation resistant than aliphatic structures. Halogenated materials were not studied because they evolve corrosive halides. (MP-24)

### Coatings For Plastics

**39.16.1.** Brooks discusses the lacquering of polystyrene moldings. There are many reasons for wanting to apply a coating to a molded plastic. Adhesion is a major problem in the formulation of coatings and is accomplished by means of a solvent which will bite into the surface of the moldings and then dry out. The properties required of the coating are as follows:

1. Effective adhesion
2. No crazing effect
3. Color, luster and gloss

4. Minimum drying time
5. Simple means of application (brush, spray, or dip)
6. Resistance to temperature and humidity variations
7. Resistance to abrasion
8. Low cost

(OF-19)

**39.16.2.** Rudolph reviews the mass production painting of plastic products. In this review, photographs take the place of words in showing the various steps whereby these plastics are given decorative coatings. (OF-34)

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# EMULSION TYPE COATINGS

## CHAPTER 40

# EMULSION COATINGS

### General

**40.1.1.** Latex-base paints, near "revolutionary" in their impact a few years ago, boast still-climbing popularity. New twists, like making textured and patterned finishes, expect to bolster sales in 1954 but big hope to push up volume is drive on exterior paints. (CW-14)

**40.1.2.** Formal opening of the Gelvatex Coatings Corp. polyvinyl acetate paint plant in California in March boldfaced the fight between emulsion and oil paints. Production by Gelvatex, first to produce a polyvinyl acetate paint in the United States, will be increased sixfold by the new facilities. The new plant represents an interesting compromise between the old, multistory, gravity-flow paint plant and the "ranch style" one-level plan that has found recent favor with many firms. (CW-15)

**40.1.3.** Rowe & Bixler discuss brushing and leveling in latex paints. Brushability in latex paints has been shown to correlate with low viscosity at very high shear rates, confirming previous work of Asbeck on house paints.

For a given "consistency", 200 rpm by Krebs-Stormer or 60 rpm by Brookfield, an unhydrolysed soybean-protein thickener and protein-base thickeners in general, have been found to give lower viscosity at brushing shear rates and therefore superior brushability

The effect of evaporation on flow properties during normal brushout periods was found to be small, regardless of thickener type. A hydrophilic thickener can minimize thickening arising from penetration of the water into porous surfaces.

Leveling in latex paints appears to occur largely within the first few seconds after application, and is controlled by the viscosity of the paint, at the very low shear rates operative in the leveling process, during that time. Because of thixotropy, the very-low-shear viscosity of latex paints depends on the immediate past treatment of the sample: for this reason, leveling appears to correlate best with viscosity measured at very low shear immediately after the sample has been subjected to very high shear rates simulating the effect of brushing. Devices for making the measurements are discussed.

The superior leveling imparted to latex paints by the unhydrolysed soybean protein thickener has been traced to the temporary reduction of the low-shear viscosity by the action of brushing, permitting rapid flow-out of the film. (OD-2)

**40.1.4.** Massaro, et al, studied the pigmentation of emulsion systems. The specific aim was to determine the effect of the following types of preparation: 1) Three-roller mill, 2) High-speed mixer, 3) High Speed stone mill, 4) Colloid mill, and 5) Pebble mill upon the package stability and film characteristics of six latex paint formulations.

All of the results obtained clearly demonstrated that extreme variations in performance result from the preparation of latex paints by different procedures, even when—as in this study—only differences in the dispersion of the pigment were involved. It is believed that a number of unexpected variables in the manufacture and formulation of latex paints have been identified which, if properly controlled, may lead to more reproducible test results in the future work of this committee. (OD-12)

**40.1.5.** In a round table discussion presented at the Federation's 31st Annual Meeting in Atlantic City, October 29, 1953, water dispersed paint systems were discussed. Papers included were as follows:

Introduction
—W. J. Greco
Consumers' Reactions
—H. E. Hillman
Manufacture
—E. C. Scholl
Pigment Dispersions
—W. H. Hoback
New Acrylic Resin Dispersions
—N. J. Timmons
Binders
—H. F. Payne
(OD-17)

**40.1.6.** McLean in a lecture to the Scottish junior section of the Oil and Colour Chemists Association compared emulsion paint systems. Types covered included polybutyl methacrylate, styrene copolymer, P.V.A., polystyrene, styrene-butadiene, P.E. alkyd and styrenated oil. Polybutyl methacrylate emulsion paints exhibit the best brushability and levelling, while pentaerythritol alkyd products have the best adhesion and washability. (PM-59)

**40.1.7.** Fletcher, et al, describe a systematic investigation of the most common failures of polyvinyl acetate emulsion paints and show how the information obtained can be used to prevent the occurrence of defects.

The following problems are discussed: viscosity and shade variations during storage, stability to freezing, the development of uneven finishes, pinholing and cratering, drag on recoating, loss of adhesion including blistering and flaking, discoloration, and the ef-

fec s of efflorescence. (JOCCA-33)

**40.1.8.** Smith reviews the latest de elopments in polyvinyl acetate en ulsion paints. One of the most si nificant developments in the pa nt industry has been the rapid gr wth of paints based on emulsion po ymers.

Properties of polyvinyl acetate w ich make it suitable as a paint ve icle include, transmission of w ter vapor in either direction, st bility of emulsions of polyvinyl ac tate, good life indoors and out, on ly water needed to wash out br ush or roller, surface of polyvinyl ac tate emulsion paints improve with age, unaffected by fats, vegetable and animal oils, adhesion is satisfactory over wide range of surfaces, emulsion paints used as stain barrier over asphalt, ease of application, good freeze-thaw stability. (CPVM-7)

**40.1.9.** Smith continues his review of the latest development in polyvinyl acetate emulsion paints. In this second article he discusses pigments, fillers and extenders, water, and other ingredients used in their manufacture. Also included is a discussion of the compounding of polyvinyl acetate emulsion paints. (CPVM-11)

**40.1.10.** Ulrich discusses the theory and practice of vinyl emulsion coatings. Topics discussed include film formation and properties, freeze-thaw stability, pigmentation, whites and extenders, yellows and reds, blues, greens and blacks, aluminum, pigments affect viscosity, pastel shades, making the paint, storage, film characteristics, application, as finish or undercoat, and other uses. (PT-2)

**40.1.11.** Payne reviews latex paints. Included are: introduction, comparison with oleoresinous paints, composition of latex paints, plasticizers and alkyd resins, protective colloids, pigment dispersion, surface active agents, defoamers, freeze-thaw resistance, efflorescence, pigments, methods of manufacture, and method of film formation. 36 references are cited. (POCR-3)

**40.1.12.** Henson presents lecture XI in the Third Ten-Year Practical Paint Course Sponsored by the New England Production Club. The lecture, on latex paints, was followed by a question and answer period. (APJ-2)

**40.1.13.** Schroeder discusses latex paints. Included are pigmentation, extenders, protective colloids, and latices (polystyrene, polyvinyl acetate, acrylic). (APJ-3)

**40.1.14.** The method of forming a multicolor coating composition comprising providing a plurality of differently colored lacquer portions, mixing each of said portions with an aqueous suspension of a protective colloid at an elevated temperature, diluting each of said mixtures with water and combining said diluted mixtures. (USP-53)

**40.1.15.** A stable lactic casein solution comprising lactic casein which has been freed from active proteolytic enzymes by heat treatment in the range of about 30 minutes at about 150° F. and about 10 to 30 minutes at about 170° F., water to produce approximately a 10% to 30% by weight lactic casein solution, and, for each 100 parts by weight of lactic casein, between about 10 and 40 parts by weight of borax, between about 2.5 and 10 parts by weight of boric acid, between about 1 and 5 parts by weight of a sodium salt of a mono-chlorphenylphenol and between about 0.25 and 1 part by weight of sodium pentachlorphenate.

A stable pigmented emulsion paste paint made by intimately mixing a mixture comprising between about 20 and 60 parts by weight of a stable lactic casein solution as described in claim 1 together with approximately 4.3 parts by weight of a drying oil, approximately 2.0 parts by weight of an ammonia soap, approximately 9.6 parts by weight of a mineral pigment and approximately 46.4 parts by weight of a mineral filler. (USP-64)

**40.1.16.** A coating composition comprising an aqueous solution of potassium silicate of 15° to 25° Be. as a vehicle and containing about 8 to about 11 pounds, per gallon of vehicle, of a composite pigment materials in proportions by weight within the indicated ranges:

| | Parts |
|---|---|
| Silica | 40 to 70 |
| Barium sulfate | 25 to 40 |
| Titanium oxide | 5 to 20 |

and 4% to 10%, based on the volume of the composition of an emulsion composed of about equal proportions by volume of a rubber latex and an oil of the class consisting of animal and vegetable oils. (USP-134)

**40.1.17.** A paint latex comprising an oil-in-water emulsion polymerization product of a major amount of an aromatic mono vinyl compound and a minor amount of a conjugated diolefin containing stabilizing amounts of thiourea. (USP-153)

**40.1.18.** Sherwin-Williams introduced Applikay—a translucent, opalescent paint for application by an embossed plastic roller over Super Kem-Tone latex paint; both paints being water-thinned.

cf: 1.2.1
19.3.1
19.4.5
21.1.12
23.1.2
36.8.1
36.8.5
38.1.13
44.2.21
46.1.8
46.1.17
49.3.1

### Interior Wall Paint

**40.2.1.** Holmes discusses the decoration of fibrous plaster with water paints. Defects in water paint films to fibrous plaster are described. Fibrous plaster—a lining material widely used in Australia—although an excellent product in many respects has certain unusual physical characteristics. These are accentuated by its mode of employment as a wall and ceiling lining and give rise to certain difficulties when decorated with water paints is attempted.

Investigations into the nature of certain of these defects are described. A common form of discoloration is shown to be the sulphides of heavy metals, chiefly lead, introduced as driers when the plaster is sealed with oil-bound composition: the sulphide radical is believed to result from bacterial decomposition of protein in the water paint.

Field studies are described which illustrate the utility of oil-bound sealers in reducing flaking of water paint films but it is pointed out that the sealers used must be free from drier metals that could cause sulphide staining.

Some aspects of mold growth on water paints are discussed. Under certain circumstances mold growth is stimulated by the physical prop-

erties of fibrous plaster linings.

Since both fibrous plaster and ordinary water paints have limitations which may interact critically it is desirable either to take special precautions as regards the treatment and installation of the sheet or to employ paints that are less susceptible to the effects of moisture and microbial action than the simple water paints. (JOCCA-29)

**40.2.2.** The widespread acceptance of latex paints has been due to the outstanding advantages which they offer. Bertollo describes their composition, manufacture and properties. Although they are a commercial success, very little is known concerning their actual colloidal structure and the specific effects of the individual paint components. (IR-1)

**40.2.3.** Davis discusses the formulation and manufacture of interior flat latex-emulsion wall paints. The author covers pigments and extenders, pigment volume concentration, pigment aids and dispersants, emulsification procedures, modified latex emulsion paints, use of driers in unmodified systems, extension of wet-edge time, protein processing methods, use of thickeners, freeze-thaw stability, adhesion of latex-emulsion paints, fungicides and their use, defoamers and their use, handling and storage of latex, equipment and paint processing, important properties of latex paints. Appendix I includes various formulations for latex paints. (POCR-15)

cf: 38.2.1
38.2.8

### Exterior Masonry

**40.3.** (No abstracts)

cf: 39.9.1

### Fire-Retardant Paints

**40.4.1.** Cummings investigated an aqueous fire-retardant protective coating system of the intumescent type as a continuation of work in the development of a synthetic latex product. Twelve different types of synthetic emulsions were studied; a vinyl chloride-vinylidene chloride copolymer emulsion, was selected as most useful. Properties of the oven-dried coating studied include wet scrub-resistance, quality of intumescence, and resistance to conditions of high temperature and high humidity. (IEC-87)

**40.4.2.** A water reducible potentially reactive fire-retardant coating composition which comprises in combination: (1) 1% to 10% of an alkaline catalyzed amide-aldehyde resin wherein the amide is selected from the group consisting of urea, thiourea, butyl urea, hydroxy urea, ethanol urea, guanyl urea, diethylene triurea, acetyl urea, allyl urea and ethylidene urea; (2) 5% to 35% of an acidic ammonium phosphate catalyzed condensation product of an aldehyde and a second amide selected from the group consisting of cyanamide, dicyandiamide and guanidine; (3) 35% to 55% of an inorganic ammonium salt capable of releasing ammonia under flame conditions; (4) 7% to 12% of a monomeric saturated aliphatic organic compound selected from the group consisting of dicarboxylic acids, hydroxy dicarboxylic acids, acid salts and salts of said acids containing not less than 1 nor more than 8 methylene groups and (5) the remainder of the composition consisting of a blend of pigments comprising china clay and zinc oxide. (USP-138)

# APPLICATION AND FINISHING METHODS

## CHAPTER 41

# SURFACE PREPARATION

### General

**41.1.1.** Miller & Hedman describe a simple test procedure for screening metal cleaners, a test which can be used for determining optimum cleaning cycles for metal panels. The methods for preparing the test specimens and representative examples of the data obtained are included. (ASTM-6)

**41.1.2.** The reasons for priming Keene's and similar plasters following the trowel and the related questions of the composition of plasters and of primers were discussed by Mack before a meeting of the London Section of the O.C.C.A. This is a report on that lecture, and on the discussion following the lecture. (PM-32)

**41.1.3.** Prerequisite for most metal finishes is a clean metal surface. You must consider contamination present, the metal, part design, subsequent operations, equipment needed, operating conditions, special precautions, production volume, and cost, in selecting metal cleaning methods. Campbell presents a complete and unique comparison of standard metal cleaning methods that will help in the selection of the optimum method for the individual particular application. (MM-2)

**41.1.4.** Trumbour reports on simposium on the subject of phosphatizing held at Bedford Springs, Pa., Sept. 1953.

Phosphatizing dates back to third century A.D. Forerunner of modern phosphate coatings traced to German patent issued in 1879 which suggests treating heated steel article in a solution of alkali and ammonium phosphate.

Phosphate coating acts as a chemical "go-between" the metal and paint film and acts to prevent undercutting or creeping corrosion from areas where a paint film has been broken as by scratching.

Phosphate coatings consist of crystals of zinc, iron or manganese phosphates deposited on the metal surface in thicknesses of 0.00004 to 0.0002 inches for paint bond application. The paint film actually becomes integral with the phosphate coating, which in turn is strongly bound to the metal surface. In essence, the phosphate coating serves as a kind of primer pigment.

A typical application cycle includes: (1) clean; (2) Rinse; (3) Pickle; (4) Rinse; (5) Activate; (6) Phosphate; (7) Rinse; (8) Chromic seal; and (9) Dry-off. (OF-3)

**41.1.5.** Further finishing of aluminum is normally unnecessary except for two main classifications of circumstances where coating is necessary or desirable. These are: to prevent corrosion under prolonged or severe exposure conditions and to maintain a particular surface appearance—mainly for purposes of decoration.

The various aspects discussed include—cleaning the surface, surface pretreatment, primers, the final surface and anodizing. (OF-6)

**41.1.6.** Engel presents a survey of metal surface soils and their removal. The metal surface soils considered include cutting oils, drawing and forming compounds, buffing compounds, and other soils. Cleaning methods include alkali cleaning, soaps, sandblasting, flame degreasing, and pickling. Two tables are included on composition of different soils (cutting oils and drawing and forming compounds-coolants), and one on the comparative efficiencies of methods for the removal of mineral oils and greases. (OF-32)

**41.1.7.** Starr discusses the new priming technique to apply corrosion-inhibiting finishes to various metallic surfaces at Consolidated Vultee Aircraft Corporation (Calif.). The technique involves the preliminary use of a thermosetting wash primer, over which a vinyl zinc chromate seal primer or cover coat can be applied. (PF-4)

**41.1.8.** Gurnham reviews ultrasonic cleaning. He discusses sonic energy generators, sonic energy losses, uses of ultrasonic energy, and ultrasonic metal cleaning. (PF-5)

**41.1.9.** Zimmerman reviews flat polishing and application to plating, painting, and sizing. The author describes the history and application of flat polishing, then goes into the construction of the machine, the principle of operation, evaluating the belt, selecting the sequence, finishing, effect of rubber, rubber contact wheel applications, and wet versus dry polishing. (PF-9)

**41.1.10.** Harris discusses recent data on sensitivity of metal cleanliness tests. An increased sensitivity radiotracer method is described, and a comparison of the sensitivities of several methods is provided. A compilation has been made of the many methods used for cleanliness, indicating the principle of action and original reference. (PF-12)

**41.1.11.** Sherwood describes emulsifiable-solvent cleaning of metals. A comparison is made of types of pre-cleaners: solvent cleaning, alkaline soak, vapor degreasing, emulsion cleaners, and emulsifiable solvent cleaners. Composi-

tion and properties of emulsifiable solvents and operating technique are discussed. (MF-3)

**41.1.12.** Barbian describes a finishing system for magnesium. The author explores 1. the requirements for finishing magnesium, 2. finishing systems currently used, 3. service experience of magnesium finishes, and 4. new developments for finishing magnesium. (IF-14)

**41.1.13.** Bardin reviews the cleaning and conditioning of metal surfaces for coatings. Metal cleaning and surface treating, in preparation for the application of organic coatings have been developed to such a degree that it is now possible to economically process any metal product, regardless of what is on its surfaces. Choice of methods, materials and facilities will depend upon the product and individual plant conditions, plus the volume and speed of production that are wanted. (IF-32)

**41.1.14.** Gibson discusses the the preparation of metal surfaces for industrial finishes. The author covers the cleaning of metal surfaces, organic solvent cleaning, alkali cleaning, emulsion cleaning, pickling, mechanical cleaning, chemical coatings, phosphate coating, phosphates coating mechanism, operation of process, paint tests, and summary. (APJ-53)

**41.1.15.** Johnson discusses metal preparation prior to painting to get the most out of metal finishes. The author reviews the removal of greasy substances, vapor phase degreasing the best; rust removal, most common method; surface etching and passivation; proper etching; and equip for size. (CPVM-19)

**41.1.16.** Schleicher in part I of his article on protection of steel discusses the importance of surface preparation.

Methods discussed are:

I Chemical and Solvent Method
- a. natural weathering
- b. solvent cleaning
- c. pickling
- d. phosphate treatment

II Physical Methods
- a. hand cleaning
- b. power cleaning
- c. sand blasting
- d. flame cleaning

(PIM-24)

**41.1.17.** A composition for treating solder metal surfaces that have been prepared for such treatment by application thereto of an alcohol solution of phosphoric acid consisting of about 69% by weight of metallic zinc dust, about 13% by weight of pigment zinc chromate, and about 18% of an isopropyl alcohol.

An article including a solder-metal area having surface pits or cavities filled with a reaction product which results when an alcohol solution of phosphoric acid is first reacted with a solder-metal and the ensuing product is reacted with a paste of about 84% metallic zinc dust and about 16% pigment zinc chromate, said fillings being bonded to the wall surfaces of said pits by reaction of the phosphoric acid portion of said reaction product with the solder metal forming the wall of the cavity. (USP-66)

**41.1.18.** The process of concealing minor defects in a surface being covered with a flat finish of oil or water base paint consisting of first covering the defect with a thick paste consisting of common ground mica mixed with a sufficient quantity of the particular covering paint, and thereafter applying the paint while the paste is still wet. (USP-71)

**41.1.19.** Chas. Pfizer & Co., Inc. has issued 3-page technical bulletin No. 15 describing the use of citric acid and ammonium citrate dibasic in the removal of rust, scale, and embedded iron.

**41.1.20.** Chas. Pfizer & Co., Inc. has issued 17-page technical bulletin No. 61 describing "Chemicals for Metal Finishing".

cf: 1.2.1

Manufacturers:
American Chemical Paint Company
Enthone, Inc.
Chas. Pfizer & Co., Inc.

### Phosphate-Type Cleaners And Treatments

**41.2.1.** Kronstein, et al, present a study of metal-phosphate coatings on steel as a base for paint application.

It is, in particular, concerned with the problem of comparing the amount of insoluble phosphate coating matter which is produced during application from a water solution of the initial material and also with a study of the effect of the remaining water soluble material present in the phosphate coating on subsequent paint applications.

A method is presented for comparing the content of water soluble matter in phosphate-coated panels. The method is also used to compare the effect of the same pretreatment materials and methods to different metals. (PVP-16)

**41.2.2.** Gabrielson has developed a method for the determination of the metals present in phosphating solutions. The method is rapid, convenient, and of sufficient accuracy for phosphating baths and concentrated phosphate solutions. (MF-1)

**41.2.3.** Ayres discusses the phosphating of steel prior to painting. The phosphating processes now in wide use for pre-paint conditioning result in the conversion of a microscopically thin surface layer of the metal into a minute crystalline film of insoluble metallic phosphates.

The coating, which is integral with the basic metal, greatly improves the metal's capacity to adsorb paint, and thus improves adhesion between metal and paint. The paint is locked to the crystals, and the crystals are locked to the metal. (IF-8)

**41.2.4.** The Detrex Corp. introduced a group of phosphoric acid-type cleaners (800 Series), intended for products that are too large or heavy to be phosphate coated by normal production methods.

Manufacturers:
American Chemical Paint Company
Cowles Chemical Company
Detrex Corporation
Pennsylvania Salt Mfg. Company

### Paint Removers

**41.3.** (No abstracts)

Manufacturers:
The DuBois Co., Inc.
Enthone, Inc.
Pennsylvania Salt Mfg. Company

## CHAPTER 42

# APPLICATION METHODS

### General

**42.1.1.** Durability of paintwork is a particular quality demanded by heavy-duty vehicle operators. To combine this with appearance and, at the same time, keep production flowing is the manufacturer's problem. At the Lancashire factories of Leyland Motors Ltd. quite a number of processes and different types of plant have been adopted to integrate production and demand. (PM-7)

**42.1.2.** Hyler describes the various finishing and allied problems encountered in the Caterpillar Tractor Company Plant in Peoria, Illinois. This plant uses sealers, primers and enamels from three leading sources of supply. Description of facilities includes testing, paint mixing and feeding, line cleaning, pickling of sheet metal, paint spraying, drying, rubber tire finishing etc. (OF-1)

**42.1.3.** Mansell describes the changing aspects of automotive finishes and their testing. Included are, how finishing materials have changed, pigmentation problems, appearance of baked synthetics, paint material and methods control, hardness, gloss, color and humidity tests, special tests for finish enamels, corrosion control, and reclamation of Over-Spray Paint. (OF-4)

**42.1.4.** DeBurgh discusses the conveyorization of furniture finishing. Finishing room techniques in furniture factories have little changed since Grand-dad's day. The introduction of spray guns represents the single great forward technical step in the past half-century. Indirect labor, should and could be estimated by the utilization of finishing room conveyorization.

The various steps needed for conveyorization are discussed. (OF-11)

**42.1.5.** Jackson describes the custom-finishing of busses and trucks as conducted at the Kenworth Motor Truck Corp. in Seattle, Washington. Phases described are cleaning and priming, assembly finishing and bus finishing. (OF-17)

**42.1.6.** Yacko describes the finishing of small parts and discusses the calculation of finishing costs. The methods for applying organic coatings to small parts fall into three general classifications:

1) Roller coating providing high-speed application and best material economy.
2) Dip finishing providing complete coverage to whatever parts are being finished.
3) Spray coating providing greatest versatility with regard to parts to be coated and materials available.

In the calculation of finishing costs, the two factors which most affect these costs are the method of application and the materials used. Approximate figures for efficiency of various application methods are as follows:

| | |
|---|---|
| Spray Finishing | 30-60% |
| Spray Finishing with Electrostatic Aids | 75-95% |
| Dip Finishing | 80-90% |
| Roller Coating | 90-95% |

(OF-18)

**42.1.7.** Nesbilt describes an automobile refinishing installation in Quebec, Canada. Various aspects of automobile refinishing are included. (CPVM-8)

**42.1.8.** Walter discusses air filtering systems for finishing operations. Since an air stream is essential for carrying away vapors and this air stream must not deposit any contamination on the work, filtering the air is a must. The author discusses a number of systems including room air filters, moving viscous filters, dry air filters, electrostatic filters. He also discusses the choice of filters. (OF-28)

**42.1.9.** Ross discusses how uniforms and clean linen towels raise the morale in finishing operations. The cleanliness and particularly clean and fresh appearance of the man or woman employee does much to inspire confidence. For this reason, the matter of always having fresh, clean uniforms, and linen towels has become an important morale building point. (OF-37)

**42.1.10.** Starr describes the finishing of reclaimed materials. A variety of scrap materials-such as sawdust, leather dust, cotton flock, etc.—are now being converted into saleable products by mixing them with organic resins and using them as molding or casting compositions. The finishing of these articles to make them presentable and saleable involves a number of considerations. For example, reclaimed wood molding must be finished like standard wood products, for they are almost as porous as kiln-dried timber. (OF-45)

**42.1.11.** Blount describes the finishing of surgical equipment at the Ohio Chemical and Surgical Equipment Co. (Madison, Wisc.) Exacting requirements of equipment for our nation's hospitals makes necessary a wide variety of durable corrosion—resistant sanitary finishes which at the same time must create a pleasing ap-

pe rance for these important products. (PF-1)

**42.1.12.** Fecht discusses work simplification programs for the metal finisher. The Who, What, Where, When, How and Why is divided into two groups:

A. Work Simplification Process:
   1. State the problem
   2. Gather the facts
   3. Analyze the facts
   4. Develop the solution
   5. Apply the solution

B. Solving the Problem:
   1. Select an operation to improve
   2. Break down the job in detail
   3. Question the job and each detail of the job
   4. Develop the new method
   5. Apply the new method

(PF-7)

**42.1.13.** Van Deventer discusses automotive paint processes and equipment. Not only are paint processes and equipment interdependent with material, but in many cases one portion of the process will have a definite effect on many of the operations. In order to produce paint jobs of the required durability at minimum cost, each part of the painting process must be carefully evaluated along with the associated equipment.

Improvements in all operations which have a part in producing a surface of the best quality prior to application of color coats can have a substantial effect on the finished job. (PF-10)

**42.1.14.** Hutchinson discusses flocoating and electrostatic airless atomization in modern industry. Modern flocoat machines are so constructed that practically all of the material consumed ends up on the work being painted. Then, coverage figures of something like 1800 ft. 2/gal. are possible in production. (PF-11)

**42.1.15.** Burt describes the painting of McCulloch engines. Operations include solvent spraying (cleaning), water wash spray booths, hot spraying of prime coats and enamels, overhead electric ovens, overhead monorail and flat-bed conveyors, and facilities for final testing and inspection. (IF-1)

**42.1.16.** Deisenroth describes the preparation and painting of metal furniture at the Troy Sunshade Company (Ohio). (IF-2)

**42.1.17.** Blackmore reviews a half decade of finishing progress. Mention is made of epoxy type resins, higher solids finishes, vinyls, silicone resins, etc., offer special merits, water thinned paints offer problems and possibilities, new sealer for modern wood finishes, paints sprayed from aerosol containers, electrostatic spraying, airless atomization, flow coating, catalytic fume combustion and a consideration of what the future may bring. (IF-5)

**42.1.18.** Seiwert reviews the painting of small parts using an adaptation of a conveyorized type finishing system (normally requiring a large amount of floor space), which requires a minimum amount of floor space. It is designed as an integral assembly so that it can be moved to any location in the plant in case layout rearrangements are made later. (IF-10)

**42.1.19.** Jackson describes the custom painting of truck cabs and chassis at the Freightliner Corporation Plant at Portland, Oregon. Custom jobs call for a variety of materials. A new paint specification sheet has to be made up for each order. (IF-13)

**42.1.20.** The development of facilities for applying coatings has been greatly accelerated since the use of protective and decorative coatings on practically all types of products has been elevated to its rightful place of importance throughout most industries.

Industrial establishments are now using facilities that produce perfect conditioning of:

1. surfaces to be coated
2. coating materials about to be applied
3. air as to its temperature, humidity, and rate of flow in the area where the coating operation occurs.
4. air movement in the drying area or baking oven.

(IF-17)

**42.1.21.** Connelly discusses how pin-holes can result from any of several causes and remedies for same. For less mahogany finish trouble, fill carefully, dry carefully, and spray carefully. (IF-18)

**42.1.22.** Jarus and Grezanik describe the finishing of lighting fixtures. Two methods of metal cleaning are used, fluorescent fixtures are hand sprayed in white, parts for fixtures are coated by electrostatic spraying, and coated parts are infra-red oven baked. (IF-21)

**42.1.23.** Gauss describes how Studebaker improved its body painting setup. Improvement of the finish was achieved by the application of a heavier film of primer surfacer than was practical on most cars. Since facilities to apply this heavier coat were inadequate, new electrostatic spraying equipment was installed. (IF-23)

**42.1.24.** Roberts describes the automatic cleaning flow-coating and baking of "Mult-A-Frame" steel channels. These channel frames come in standard 10-ft. and 20-ft. lengths, and since they must be coated both inside and outside, they travel through the entire system in a vertical position. The entire finishing system is a mechanical operation even to loading and unloading the conveyor. (IF-24)

**42.1.25.** Stewart describes a conveyorized setup that includes cleaning and phosphatizing of steel parts, dry-off oven, tack rag wiping, pressurized spray room, central mixing-storage facilities, electrostatic automatic spraying of heated paint material, supplementary hand spraying and oven baking—designed to take care of processing parts of many different sizes. (IF-27)

**42.1.26.** Syer describes the painting of metal products in Singapore. The author spent 5 months observing operations in a plant manufacturing metal containers. Metal finishing in Singapore is a far cry from what it is in the United States. (IF-28)

**42.1.27.** Chester describes the troubles which can be encountered in using silicon-containing finishing materials. The main trouble is the formation of "pits" in the finish causing rejection. (IF-30)

**42.1.28.** Syer continues his description of painting metal products in Singapore. (IF-39)

**42.1.29.** Rudolph describes how a new cleaning-painting setup has solved several problems at the Erie Plant of Detroit Steel Products Company. (IF-40)

**42.1.30.** Syer continues his article on painting steel drums in Singapore. (IF-41)

**42.1.31.** Golding describes the painting of military planes at the Columbus Division of North American Aviation, Inc. (IF-45)

**42.1.32.** Silver describes the flock coating of fiber board. The adhesive is spread by a roller coater, rayon flock is put on by machine, and the fast drying is effected in an infrared oven on an automatic production line. (IF-49)

**42.1.33.** Marshall, in Lecture XVII in the Third Ten-Year Practical Paint Course sponsored by the New England Production Club, discusses application and rigging. Rigging refers to the means of getting the person applying in the best possible location to make his application. Application refers to the devices or means used to carry the paint from the can or paint pot to the surface where it is to go. (APJ-24)

**42.1.34.** Slocum reviews the methods for application of paints. The author discusses spraying, electrostatic spraying, hot spray application, dip coating, flow coating, roller coating, etc. Any product that can be dipped also can be flow coated, but the reverse is not true. (APJ-64)

**42.1.35.** Cook describes the finishing of heating specialties—enclosures for radiators and component parts for heaters, etc.,—at the C. A. Dunham Co., Ltd. (Toronto). A special type of paint is required because these enclosures and parts are subjected to many attacks during use. The paint must be resistant to heat, alkali, etc. (CPVM-16)

**42.1.36.** Cook describes the finishing of typewriters at Smith-Corona (Toronto). The methods and materials used are discussed. (CPVM-23)

**42.1.37.** A small but ingenious finishing system turns out quality lacquer finish on pens and pencils. Nitrate lacquer is used. (CPVM-25)

**42.1.38.** Cook describes quality finishing at Mitchell Mfg. Co. (Toronto). In a carefully planned finishing department, they handle a wide variety of lighting fixture parts. (CPVM-31)

**42.1.39.** Cook describes the finishing of fire engines at the La France plant in Toronto. (CPVM-36)

### Spray

**42.2.1.** Tilney describes the development of three techniques for electrostatic paint spraying. The first is an air atomised spray process. Next is the electrostatic detearing process. The third and most recent development is the use of an electrostatic field both to atomise the coating material and to deposit it on the workpiece. (PM-8)

**42.2.2.** Fairrie offers a simple explanation of the hot spray process; its advantages and method of operation. Already 90% of industrial painting in Sweden and 50% of that in Holland is carried out using the hot spray process. It is, therefore, natural that Swedish engineers and chemists, by virtue of their overall experience, should have developed two really efficient plants designed in conjunction with the paint industry. (PM-9)

**42.2.3.** Hindle concludes that in the spray technique for the application of paint, modern man was anticipated ten to twenty thousand years ago by his cave-dwelling ancestors. He bases this on the discovery in certain caves in southwestern Europe, of pictures painted by various races of palaeolithic man wherein many of the figures, and especially the manes of horses, have smoke like outlines. The pigment was almost certainly blown on to the surface either in the form of powder or a dilute suspension. In support of this view, hollow bones filled with pigment have been found scattered about on the floor of the cave. (PM-19)

**42.2.4.** Preuss describes how standard spray gun parts can be varied to accomplish specific purposes and describes special types of guns developed for unusual applications. (OF-2)

**42.2.5.** Pouilly discusses the spray-application of porcelain enamel. Various types of equipment and proper spray technique are discussed. (CPVM-3)

**42.2.6.** Austin of England has spent much time and money in developing an efficient dual finishing system. Various phases of the finishing of Austin Motor Cars at Birmingham, England are described. (CPVM-13)

**42.2.7.** Rudolph describes the painting of water heaters at the Hotstream Heater Co. (Ohio). Increased production was being bottlenecked by its painting department. Study of the plant and painting requirements evolved two painting "lines" for large and small water heater components and various other products. Heart of the new painting "lines" are electro-static painting booths, fed by several hundred feet of monorail conveyor. (OF-20)

**42.2.8.** Stewart discusses the electrostatic finishing of freezers and air conditioners at the Amana Refrigeration plant (Iowa). An important phase of their plant is a new, complete electrostatic-two-coat, two-bake finishing system. (OF-25)

**42.2.9.** Pustarfi, discusses the function and design of water wash spray booths. Advantages of wet booths over dry booths are:

1. Present high speed production requires full time operation of spray booths. Dry booths are inadequate for this service since the over-spray deposit on the walls of the booth requires a disproportional amount of cleaning time to prevent a serious fire hazard.
2. Paint overspray in dry booths constitutes a definite health hazard.
3. Wet booths cut down on number of damage suits resulting from the deposit of air borne spray to neighboring cars and buildings.
4. Efficient water wash booths are more economical to operate, since maintenance costs and down time are reduced to a minimum.

(OF-26)

**42.2.10.** Renfrew & Freeman review the flame-spraying of plastic coatings. The application of plastic coatings by a non-solvent flame-spray technique followed the development in Europe of special equipment for the flame spraying

of powdered metals. Solvent-free coatings offer superior barrier properties in protecting metal surfaces against corrosion, mainly because a thick film can be deposited. Advantages are as follows:

1. heavy film without seams can be applied
2. thickness can be varied allowing heavier coating at points of heavy wear
3. no solvent hence no solvent retention
4. coating is "ready-for-use" on cooling—no "drying time"
5. odd shapes can be coated.

Disadvantages include:

1. flame spraying is an expensive operation
2. plastic tends to be degraded in the operation.

(OF-33)

**42.2.11.** Racine describes the progress made in water wash spray booth maintenance. To keep these booths operating efficiently at low cost, it is necessary to use a paint booth compound in the recirculated water. The purpose of this compound is to prevent the overspray from adhering to the walls of the booth and/or clogging the pumps and piping of the water circulating system. General recommendations are given for different types of paint sprayed. (OF-36)

**42.2.12.** Prauss describes the airless spray of finishes. Airless spraying allows the finishing of machinery units too large to move into a spray booth. Because of more efficient utilization of material, nearly 90% of material wastage is eliminated. The system provides a 50% increase in the finishing speed.

The system involves building up a pressure in the fluid which is then heated to a predetermined value. Heat lowers the viscosity and it builds up a vapor pressure whereby the tail-end fractions of the solvents are brought to a boiling point, and upon release to atmosphere the flashing off of the solvent assists in atomization, thus the solvents within the paint are used as an atomizing agent. (OF-44)

**42.2.13.** Pouilly discusses the electrostatic spraying of porcelain enamel. Much has been done to obtain in the porcelain enamel field, the high degree of efficiency enjoyed in the electrostatic spraying of synthetic paints. (PF-3)

**42.2.14.** Green discusses spray gun efficiency. The author describes the production spray gun, air valve of spray gun, fluid valve of spray gun, graduated spray width adjustment, spraying procedure, the spray gun cap, multiple jet air cap, fluid tip or material nozzle, training the operator, adjusting spray guns on a circulating system using lacquer, and defective work by good air cap; causes and remedies. (IF-3)

**42.2.15.** Beacham reviews spray equipment, including improved spray guns, low pressure spraying, circulating paint systems, steam spray, catalyst spray, light weight guns, automatic spray systems for long runs, hose, hose connections, air cleaner-filters, spray booths and spray exhaust systems, and flock coating by modern spray methods. (IF-9)

**42.2.16.** Bede discusses airless spray, an outgrowth of hot spray. Hot spray was made possible by the development of a practical and acceptable electric explosion-proof paint heater. A logical outgrowth of the hot spray process with the heated paint has been the airless atomization of the heated paint. All types of finishes are adaptable to airless spraying. Airless spraying opens up an entirely new level of operation in spray painting operations. Not only will it eliminate much of the waste, but it will also produce an excellent finish with great adhesion and a number of other fine qualities. (IF-11)

**42.2.17.** Slikkers describes the painting of steel equipment for stores by the Bulman Co., Inc., manufacturers of adjustable steel wall shelving, counters and island display units. (IF-16)

**42.2.18.** Rudolph describes the painting of factory-made steel panels for new partitions. This includes putting on adhesive to bond sheet steel to thick paper backing, cleaning surfaces of metal panels by wiping with solvent and tack rag, electrostatic spray painting both the primer and the enamel, baking in a gas fired oven, then safe packaging. (IF-20)

**42.2.19.** Frederick presents an example of equipment designed and put in to provide an adequate supply of filtered, preheated, make-up air, for use in a paint spray room that has only two spray booths. (IF-26)

**42.2.20** Samuelson describes the electrostatic spraying of shock adsorbers. Where 350 parts were formerly coated from each gallon of enamel, 1000 parts are coated per gallon. A consistent high quality, uniform coating is maintained too. (IF-35)

**42.2.21.** Rowe describes the panel arrestor method of removing paint overspray from air exhausted from the paint spray booths. The general method is described first, followed by a detailed description of a typical installation. (IF-37)

**42.2.22.** Johnson presents part II of "Getting the most out of Metal Finishes," Good application depends not only on quality spray equipment, but also on proper ventilation control. The question of air flow in spray booths is one of great importance as it controls the removal of overspray which would otherwise be deposited on the work. (CPVM-21)

**42.2.23.** Grinrod describes a British truck finishing booth wherein water recirculates after paint is removed by efficient water wash system. The water wash system is effective in removing overspray. (CPVM-27)

**42.2.24.** Chatterton reviews spray painting without compressed air. The airless spray system promises all the advantages of reduced overspray plus improved adhesion. (CPVM-34)

**42.2.25.** Murphy describes electrostatic paint spraying and how it improves efficiency and safety. (PIM-22)

cf: 42.1.1
42.1.22

Manufacturers:
Binks Mfg. Company
Burdett Mfg. Company
M. & E. Mfg. Company

### Roller

**42.3.1.** Hyler describes the application of finishes by roller coating. Paint and finishing materials are applied fast by the roller-coating method and the machines used are readily operated by semi-skilled workers. The author describes the roller coater and glue spreader similarity, the different

material handling arrangements, the coating of fragile material, instances of temperature control, coating thin steel laminae, channeled coating rolls and localized coating on embossed work. (OF-41)

cf: 42.1.1
Manufacturer:
The Sulzer-Waegner Company

### Dip & Flow Coating

**42.4.1.** Blount discusses the flow coating of range and heater parts. Flow coating is one of the newer techniques employed in recent years. A new installation for finishing various range and heater parts by conveyorized low pressure flow coating has just been completed in the plant of the R.C.A. Estate Appliance Corporation (Ohio). (PF-6)

**42.4.2.** Improved methods, equipment and techniques have been developed for flow coating parts and products safely, effectively, and economically on a mass production basis. Several companies have designed and installed flow coating equipment. (IF-12)

**42.4.3.** Frymire & Fenton describe the flow coating of electric range parts. No comparison is made of the relative merits of high and low pressure flow coating systems. (IF-19)

**42.4.4.** Bardin describes the flow-coating of a food waste disposer at the General Electric Company's Major Appliance Division. The entire system was worked out on a pilot installation in the laboratory of the enamel supplier and uses low pressure flow-coating as the means of paint application. (IF-33)

**42.4.5.** Brenaman describes flow coat priming by Northrop Aircraft, Inc. Every part must be finished in a manner to completely preserve its physical characteristics throughout its service life. No surface corrosion is permissible. The finish coating must act as an impermeable barrier between the part itself and external corrosive influences at all times and under all conditions. Flow coating provides this and has replaced their spray (hand) booths with automatic finishing equipment. (IF-42)

### Aerosol

**42.5.1.** Kester discusses aerosol opportunities for paint manufacturers. During the last 6 year aerosol dispensing of paint ha come a long way. The America public has accepted the aeros application of coatings, and wi continue to express its confiden in such products to the degree th improvements are made so tha there will be a minimum of di appointment by the consumer (APJ-50)

**42.5.2.** E. I. du Pont de Nem ours & Co., Inc. has issued "Th Aerosol Market-Report of 195 Dealer Survey", a 20-page study o retail distribution practices fo aerosol products.

**42.5.3.** E. I. du Pont de Nem ours & Co., Inc. has issued "The Aerosol Market-Report of 1953 Consumer Survey", a 28-page study of consumer knowledge, use and opinion of aerosol-packaged products.

**42.5.4.** E. I. du Pont de Nemours & Co., Inc. has issued 32-page brochure "Package for Profit"—information about the expanding aerosol market and the use of Freon safe propellents.

cf: 39.1.46
46.6.2

## CHAPTER 43

# DRYING METHODS

### General

**43.1.1.** Brown describes the force drying of wood finishes. The author discusses the processes involved or included in drying the different finishes on wood—evaporation of solvents, oxidation and polymerization. He discusses the temperatures, humidities, air movement and time periods required in the heat tunnels or ovens to properly force dry these various coatings rapidly, efficiently and economically. (IF-34)

**43.1.2.** Gaynes describes some causes of and several remedies for fouled ovens, in connection with baking paints and finishes on metal surfaces. (IF-46)

**43.1.3.** Johnson presents Part III of his article on getting the most out of metal finishes. The wise selection and use of a bake oven will result not only in better finishes, but also lower operating costs. In this third part, the author discusses the selection and use of ovens. (CPVM-33)

cf: 42.2.18
Manufacturers:
Burdett Mfg. Company
Despatch Oven Company
General Electric Company
George Koch Sons, Inc.
Ovens for Industry, Inc.

### Infra-Red

**43.2.1.** Gas infra-red drying has been developed to the point where various shaped items can be handled by one oven. Walter reviews a number of types of infra-red, gas-fired drying ovens and tunnels. (CPVM-1)

**43.2.2.** Walter discusses the use of gas-fired equipment as a source of infra-red radiant heat. Some of the practices, as used in England and described in this article, are contrary to those in common use in the United States. The following are discussed: fundamentals of heat radiation, source of heat, gas as heating medium, tunnel baking by radiant heat, smaller ovens, factors governing the choice and method of using radiant heating equipment for paint, flux density determines drying time, convection currents and shadows, and articles with varying sections and shielded surfaces. (OF-39)

cf: 42.1.22
Manufacturers:
Burdett Mfg. Company
The Fostoria Pressed Steel Corp.
General Electric Company
Industrial Radiant Heat Corp.
George Koch Sons, Inc.
The Miskella Infra-Red Company
North American Electric Lamps Company
The Op-Al Electric & Mfg. Company
Ovens for Industry, Inc.
Penetray Corp.
Sill Industries
Swenson Associates
The Trippe Mfg. Company

# PRODUCTION TECHNIQUES

## CHAPTER 44

# CHEMICAL REACTIONS

### General

**44.1.1.** Shur discusses high polymer chemistry in protective coatings. The formulation of vehicles for the paint industry is no longer dependent upon the jealously kept and secret art of the master varnish maker. Mechanism of polymerization, synthesis and properties, solubility and viscosity, oxidation and condensation are phases covered. (PVP-34)

**44.1.2.** Greenspan discusses epoxidation and hydroxylation reactions with hydrogen peroxide and peracids. These materials place at the disposal of the organic chemist new building blocks for synthesis to be utilized along with the older unit operations of chlorination, hydrogenation, esterification, and the like. (MP-19)

**44.1.3.** E. I. du Pont de Nemours & Co., Inc., has issued 12-page booklet on Epoxidation and Hydroxylation with Organic Peracids. Includes 120 references.

**44.1.4.** E. I. du Pont de Nemours & Co., Inc. has issued Peroxygen Products Bulletin P61—454 on Hydrogen Peroxide-Resin Technique for Epoxidation of Unsaturated Fats, Oils, and Derivatives.

### Polymerization

**44.2.1.** A study by Marvel & others of the copolymerization of butadiene with cinnamaldehyde, cinnamic acid, methyl cinnamate, ethyl cinnamate, and trans-cinnamonitrile showed that all these monomers yield rubbery copolymers with butadiene and certain of these have been evaluated and compared to current synthetic rubbers of the GR-S type. (IEC-7)

**44.2.2.** Howland, et al, have determined the applicability of several of the more economical and efficient organic antifreezes to low temperature GR-S emulsion polymerization. A new antifreeze system of some promise has been developed. (IEC-28)

**44.2.3.** Feldon & McCann studied the effect of initiation temperature on continuous emulsion polymerization. The use of "high" initiation temperatures in the precooler of a continuous emulsion polymerization system appears to be a commercially feasible method of increasing the capacity of the system. (IEC-42)

**44.2.4.** Miller & Diem discuss very rapid recipes for emulsion polymerization of GR-S at 41° F. Laboratory scale experiments resulted in three 41° F. recipes which attain 60% conversion in 11, 16, and 18 minutes instead of the 12 hours required with present production methods. Eventual commercialization of this superfast process appears possible. (IEC-57)

**44.2.5.** Brown, et al, discuss the use of sodium formaldehyde sulfoxylate in GR-S polymerization. The use of this material will allow good rates of polymerization with rosin soap as emulsifier. (IEC-58)

**44.2.6.** Labeled reagents used in British laboratory give better picture of polymerization reactions and structure of polymers. A comprehensive program using radioisotopes for investigating vinyl polymerizations is under way at the University of Birmingham. (CEN-22)

**44.2.7.** Wiegandt & Thorpe present the 1953 review of polymerization. The number of 1953 publications dealing with polymerization is approximately 15% fewer than for the previous year. The review includes 468 references. (IEC-80)

**44.2.8.** Russell & Tobolsky have produced diradicals by the photolysis of 1,4,5-oxadithiacycloheptane. A minimum value for their rate of formation in benzene solutions is given the rate of disappearance of 2,2-diphenylpicrylhydrazyl. In methyl methacrylate the great majority of the diradicals either undergo primary recombination, or form small rings after the addition of one or two monomer units. Few, if any, of the diradicals grow to form long polymer chains. The photolysis of butyl sulfide has been investigated so that comparisons can be made with a disulfide source of monoradicals. The photodecomposition of the trans-annular peroxide ascaridole has been shown to lead to monoradicals. (JACS-27)

**44.2.9.** Overberger, et al, studied the effect of different Lewis acid catalysts on the monomer reactivity ratios in copolymerization. With the system styrene-p-chlorostyrene in solvent mixtures of $CC1_4$ and nitrobenzene, no difference in monomer reactivity ratios were obtained with aluminum bromide, ferric chloride, titanium tetrachloride, stannic chloride, and titanium tetrachloride-trichlorocetic acid as catalysts in homogeneous solution. The insensitivity of monomer reactivity ratios in this system to changes in dielectric constant and catalyst concentration previously noted with a stannic chloride catalyst was verified with other catalysts. (JACS-34)

**44.2.10.** Bevington, et al, polymerized styrene and methyl methacrylate at 25° using $\alpha,\alpha'$-azo-bis-isobutyronitrile labeled with $C^{14}$ as initiator. The number of initiator fragments per polymer mole-

cule were determined by measurements of the average molecular weights of the polymers by osmometry and the specific activitivities of the polymers and the initiator by gas counting. It is found that polystyrene radicals combine at 25° and that for polymethyl methacrylate radicals at this temperature disproportionation occurs about twice as frequently as combination. (JPS-35)

**44.2.11.** Hicks & Melville describe the synthesis of block copolymers in a flow system. Such copolymers are molecules containing two components in which each component is not distributed randomly as in a copolymer but segregated to a definite part of the molecule. (JPS-36)

**44.2.12.** Bevington, et al, present a new method for the determination of the rate of initiation in radical polymerizations. The rate of initiation is equal to the over-all rate of polymerization divided by the kinetic chain length, and so it can be calculated. It is shown that for a given monomer mixture the rate of initiation is proportional to the concentration of initiator, and that for each initiator molecule decomposed approximately one reaction chain is started. (JPS-37)

**44.2.13.** Plesch presents part II of developments in the theory of cationic polymerization. Olefins can only be polymerized by metal halides if a third substance, the cocatalyst, is present. The function of this is to provide the cation which starts the carbonium ion chain reaction. (JPS-38)

**44.2.14.** Patal, et al, describe, quantitatively, the addition of ethylene oxide to phenol. The reaction takes place by an ion chain. (JPS-39)

**44.2.15.** Fisch & Hofmann discuss the reaction mechanism of ethoxylene resin. In the course of the alkaline condensation of epichlorhydrine with bivalent phenols, aliphatic-aromatic polyethers containing hydroxy—and terminal oxido groups are formed. The reaction of products of this kind with dicarboxylic acid anhydride yields highly cross-linked, valuable resins. (JPS-40)

**44.2.16.** Process for the production of polyacrylic nitrile by polymerization of acrylic nitrile in aqueous dispersion in the presence of water soluble redox catalysts, characterized in that the dispersion is maintained under superatmospheric pressure and at a pH value of about 4 to 5 solely by the presence of dissolved carbon dioxide. (USP-4)

**44.2.17.** In method of polymerizing a composition comprising a liquid monomeric unsaturated compound in which the unsaturation is due to a single terminal ethylenic group which is attached to a negative radical and which unsaturated compound is polymerizable in the presence of a peroxy polymerization catalyst, said catalyst also being present, that improvement which consists in the step of adding a small but effective amount of a compound selected from the group consisting of 1,2,3,4-tetrahydroquinoline and the N-alkyl, N,hydroxyethyl, N-cyanoethyl, and 2,7-dimethyl substitution derivatives of 1,2,3,4-tetrahydroquinoline to promote gelation of the composition. (USP-15)

**44.2.18.** In the preparation of a synthetic rubber latex by the polymerization of an aqueous emulsion of a mixture of butadiene-1,3 and styrene, the steps which comprise adding to the emulsion 0.1 to 1 part by weight of a xanthogen polysulfide containing 3 to 7 sulfur atoms per 100 parts by weight of polymerizable material initially present, said xanthogen polysulfide addition being the first addition of the chemical and said addition being after conversion of 50 to 90% of the polymerizable material originally present in the emulsion to synthetic rubber to stop polymerization of unreacted polymerizable monomeric material, and thereafter removing unreacted polymerizable monomeric material from the latex. (USP-82)

**44.2.19.** A process for the suspension polymerisation of styrene which comprises polymerising styrene in aqueous suspension in the presence, as a suspension stabilizer, of suspended, finely divided particles of a substantially neutral calcium oxalate. (USP-90)

**44.2.20.** The method of polymerizing monoethylenically-unsaturated, polymerizable, organic compounds of the class having a terminal ethylenic double bond, which includes the steps of dispersing 1 part by weight of a material of said class in not more than 4 parts by weight of an aqueous acidic medium including a mixture of water, sulfite ions, and chlorate ions, said sulfite ions being in excess of the equivalent molecular proportion of said chlorate ions, maintaining the pH of said medium substantially within the range of 2-6.5 during the polymerization reaction, and recovering a homopolymer of said class from said medium. (USP-105)

**44.2.21.** Hollis & Turner give an outline of the mechanism of radical-initiated vinyl polymerization, and the effects of radical-transfer reactions are shown, with particular reference to styrene, vinyl acetate, and butadiene. The phenomena of polymerization in aqueous emulsion are reviewed, and the swollen micelle theory of the process is discussed. The formation of a film from a layer of a given polymer emulsion when deposited on a surface is shown to depend largely on surface tension forces, and hence on the amount and type of plasticizer, external or internal, present.

A general survey of the properties of emulsion paints based on polystyrene or polyvinyl acetate is given, and the inter-related questions of sedimentation, paint consistency and ease of application are discussed. Particle size of the polymer emulsion, and the protective colloids present both have an important influence on stability and flow properties. Secondary changes in the film which follow the first film integration step are shown to be important, if as yet little understood. General conclusions are given, based on several years work, as to the principles, which must be followed in the formulation of a satisfactory emulsion paint based on polyvinyl acetate or polystyrene. (JOCCA-32)

cf: 2.1.13
8.1.1
9.2.1
12.3.5
16.1.5
16.1.8
18.4.1
19.4.8
35.1.15
35.2.1
36.2.1
44.1.1
44.3.1

**Oxidation**

**44.3.1.** This article includes three post graduate lectures delivered by Bawn. The first, "The Chemistry and Mechanism of Oxidation Reactions in Liquid Systems" includes the primary products of the liquid phase oxidation, general kinetics of autoxidation reactions, and influence of structure on the rate of oxidation. The second, "Metal Catalysed Autoxidation" includes the nature and function of the catalyst, and inhibition of oxidation. The third, "Secondary Processes of the Autoxidation" includes hydroperoxide decomposition and the effect of oxygen on polymers and polymerization processes. (JOCCA-1)

**44.3.2.** Frye, et al, studied the possible retarding effect of the lower aliphatic alcohols, methanol, ethyl alcohol, isopropyl alcohol, and tert-buty alcohol, on the oxidation of four unsaturated hydrocarbons.

The mechanism originally proposed by Robertson and Waters appears to be applicable with modification to this case and may provide a more general understanding of the factors retarding peroxide formation. All four alcohols accelerated the oxidation of tetralin and cyclohexane but retarded that of diisobutylene and 1-octene. The oxidation of mixtures of diisobutylene with tetralin and cyclohexene was also retarded.

With suitable blending, peroxide formation can be retarded with alcohol addition, in all cases. (IEC-66)

**44.3.3.** Mosher and Preiss studied the mechanism of aldehyde and primary alcohol oxidation. The oxidation of primary alcohols with chromic acid generally leads to the formation of appreciable amounts of ester which may be explained in three ways: direct esterfication of alcohol with the acid formed from it by oxidation, hemiacetal formation and subsequent oxidation to ester, or oxocarbonium ion formed by oxidation of aldehyde and the attack of this on alcohol. (JACS-11)

cf: 36.2.1
44.1.1

## CHAPTER 45

# VEHICLE MANUFACTURE

### General

**45.1.1.** Yokell presents a paper discussing the designing of equipment for vehicle manufacture. For many years vehicle making was a cook's art. Advances in chemistry brought the second period with closed cooking equipment and solvent cooking. The third period, now upon us is the period in which the production man has digested his experience with the new type of equipment. His questions on design are pointed and intelligent, and he is full of them. The author then proceeds to discuss the various aspects of modern kettle equipment design and construction. (PVP-27)

**45.1.2.** Philip reviews the various types of reaction kettles used in synthetic resin production. The types used can be grouped under three headings—directly heated, indirectly heated and electrically heated. The latter in turn can be a) jacketed with immersion heaters supplying heat to the surrounding fluid, b) encircled with resistance heating units, c) have the electrodes immersed in the medium being heated, or d) induction heated.

Since it is almost impossible to keep one reaction kettle in use continuously making one particular type of resin, the equipment used must be suitable for a variety of reactions. (PM-21)

**45.1.3.** Walter gives an outline of the heat treatment necessary to produce the desired properties in the materials used in the manufacture of paints and varnishes. The types of burners used are described, together with a number of installations and appliances in which heating is carried out by towns gas, as available in England. A great variety of oils, resins, and gums are used in the manufacture of paints and varnishes, but for the purpose of heat treatment they may be classed as drying oils, non-drying oils, and fossil resins. (PVP-40)

**45.1.4.** In recent months, The Schaefer Varnish Company (Louisville, Ky.) has focused their attention on streamlining their facilities for better control and more automatic and efficient operation. They feel that surface coatings can be made on the same flow-sheet basis as are many other types of products, whether the batch size be small or large. (PVP-42)

**45.1.5.** Yokell discusses factors in designing equipment for vehicle manufacture. Included are materials of construction, selection of dimensions, comparison of heating methods, temperature effects, and agitation. (APJ-30)

**45.1.6.** Cooking oils and resins over open fires in open kettles is a long-established way to prepare varnish and also to spew clouds of malodorous fumes. So obnoxious were these vapors that Du Pont's varnish plant in Flint, Michigan undertook a 3-point control program as follows:

1. Closed kettles and fires cut irritant fumes from 2,000 cfm. to 45 cfm. and yield loss from 100 to 50 lbs. of oil per batch.
2. Orifice-cyclone scrubber yielded an additional 25 lbs. of oil per batch, got fumes down to a barely passable level, cost less than $1,000 installed.
3. Condenser lowered fume temperature low enough to liquify all components, recovering remaining 25 lbs. of oil per batch. (CE-22)

**45.1.7.** Yokell discusses the factors affecting the design of equipment for vehicle manufacture. Materials of construction, selection of dimensions, comparison of heating methods, temperature effects, and agitation are discussed. (POCR-19)

**45.1.8.** Rose discusses new developments in ultrasonics for dispersion. Many years of research have produced a practical ultrasonic dispersing and emulsifying tool to speed production. In the latest type of ultrasonic unit the dispersion (for emulsification) is effected by a blade which vibrates at its own frequency in the liquid stream. (CPVM-29)

**45.1.9.** Yokell discusses the factors in designing equipment for vehicle manufacture. The author discusses materials of construction, selection of dimensions, comparison of heating methods, temperature effects and agitation. (PIM-13)

cf: 47.1.4

Manufacturers:
Bethlehem Foundry & Machine Company
Brighton Copper Works, Inc.
Lee Metal Products Co., Inc.
The Pfaudler Company
Sparkler Mfg. Company

## CHAPTER 46

# PAINT MANUFACTURE

### General

**46.1.1.** Normally to check a kettle or tank for holes, filling with water will detect a leak. However where the tank is to contain an organic (like acetone, benzene or carbon tetrachloride) that has a considerably lower surface tension, a hole not detected by water could easily cause trouble. Cyanamid found that by adding a small quantity of its Aerosol OT-B, the surface tension of the water is lowered to a point where it can effectively detect minute holes. (CW-16)

**46.1.2.** Errico edits a series of 7 reviews of paint manufacturers. Pictures and stories are included for Grand Rapids Varnish Corp. (New Lacquer Plant), Glidden Co.—Atlanta Plant (Features Gravity System), De Soto Paint & Varnish Co. (With suspended Equipment), Advance Paint Company (Features Dust and Vapor Control System), Lehman Bros. Corp. (Incorporates Safety Features), Gilbert Spruance Company (Stain Plant), Devoe & Raynolds, Inc. (Jones-Dabney Laboratory). (PVP-31)

**46.1.3.** Considered the South's largest paint operation and the most modern in the nation, the new multi-million dollar paint plant of De Soto Paint & Varnish started operation at Garland, Texas. This huge plant has an annual paint capacity of 1.6 million gallons; a small amount of additional equipment and personnel could boost this figure to 3 million gallons. (CEN-4)

**46.1.4.** Manley describes a new test for welded joints. Non-destructive testing of heavy chemical engineering and allied plant has been used for a decade or two. Depending on a rather specialized improvement in the well-known ultrasonic technique, a successful novel method has been brought into commercial use for testing the welds of vessels made in steel plate up to 1½ inch thick. The technique is a distinct improvement over previous ultrasonic methods for this particular problem and has advantages over conventional x-ray techniques as well as being complementary to same. It will be possible for paint, resin, varnish and lacquer manufacturers to demand both x and/or gamma ray inspection and also ultrasonic testing of all vessels made of steels thicker than ½ inch. (PM-1)

**46.1.5.** Although small compared with some sections of Imperial Chemical Industries, Ltd., the Paints Division handles one of the largest paint, varnish and cellulose lacquer businesses in Great Britain, and employs 3,000 people in all. This series of two articles describes a visit to the Division's headquarters at Slough, Buckinghamshire (20 miles west of London), and to the factory located there. This first part describes the production departments. (PM-16)

**46.1.6.** The Slough factory is the largest of the six operated by the Paints Division of Imperial Chemical Industries Ltd. This second of two articles describes the materials handling methods and safety routines and some notes on the research organization at Slough, which boasts one of the few electron microscopes in Great Britain. (PM-17)

**46.1.7.** In a round table discussion presented at the Federation's 31st Annual Meeting in Atlantic City, October 30, 1953, production planning and scheduling was discussed.

The panel was under the chairmanship of J. W. Tomecko and panel members were A. H. Benson, J. C. Creager, H. Einbecker, R. J. Gnaedinger, W. S. Houck, and A. P. Stresen-Reuter. Mr. Gnaedinger was the Moderator. (OD-18)

**46.1.8.** A comparison of the results obtained with a colloid mill and a conventional mill indicate the former to be very suitable for the production of emulsion paints and distempers. Ford reviews a number of manufacturing methods. The results indicate that there may be a good future for high-speed machines in the production of emulsion paints. Their versatility and the ease of cleaning is particularly attractive and the ability to handle "specials" without trouble would be a great asset to the industry. (PM-52)

**46.1.9.** Fecht points out that a cost reduction program can be most successful, and successful on a continuing basis, only if it makes the company's personnel more productive through training in cost reduction. The Work Simplification technique is the logical way to reduce operating costs and it can be taught to the company's personnel through a series of interesting training conferences. These training conferences are productive of tangible, recorded and reported savings far in excess of their cost of installation and maintenance.

The ideas for method improvements and cost reduction are there, out in the plants in the minds of supervisors and employees. Those ideas are there for the asking-the asking of the six questions: What, Where, When, Who, How and Why. (OD-31)

**46.1.10.** Devoe & Raynolds has boosted production at its Malden (Mass) Plant with new equipment. This firm has found that standardization of equipment permits quick maintenance and a minimum of spare parts inventory in their stock room supply. It has consistently followed out a standardization program in installations of roller mills, filling machines, and material handling equipment. (PVP-46)

**46.1.11.** Equipment used in the paint industry is discussed and the latest products of the manufacturers reviewed. Electronic devices for the automatic control of production processes and filling, new heating systems and alternate means of dispersion are recent developments in the plant and equipment suitable for paint manufacture. (PM-66)

**46.1.12.** A new resin plant has been completed by DeSoto Paint and Varnish Co. of Garland, Texas. This company built a new paint factory in 1953, stated to be the largest in the South and one of the largest paint-resin concerns in America. Ball mills suspended from the ceilings by rubber mounts are a feature of the paint manufacturing section. These and other equipment are reviewed in this description of the new installations. (PM-68)

**46.1.13.** The DeSoto Paint and Varnish Company has opened its new plant at Garland Texas. Located on a 20 acre tract on the western outskirts of Garland's busily expanding industrial area, the huge plant has a capacity of producing 1,600,000 gallons of paint annually. This figure can be jumped to 3 million by adding a small amount of additional equipment and personnel. (APJ-12)

**46.1.14.** Singer presents chapter IX of his "Fundamentals on Paint, Varnish, and Lacquer Technology on Formulation", Part I. This chapter includes, requirements of specific finishes, type of coating, consistency, hiding power, wet and dry hiding power, pigment and vehicle ratios, types of pigments to be used, names of vehicles, constants of pigments and vehicle, oil absorption, and bulking value. (APJ-19)

**46.1.15.** Devoe & Raynolds, oldest paint company, celebrates its


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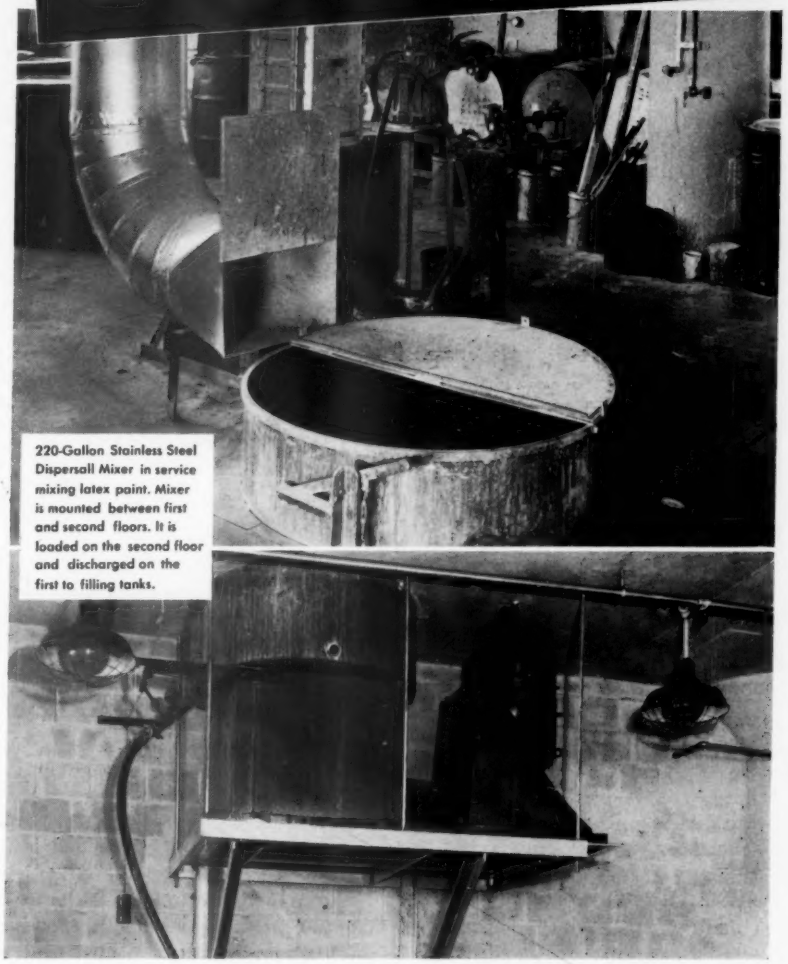
The ABBE´ DISPERSALL MIXER



220-Gallon Stainless Steel Dispersall Mixer in service mixing latex paint. Mixer is mounted between first and second floors. It is loaded on the second floor and discharged on the first to filling tanks.

1. You get *complete* dispersion of all ingredients, regardless of formulation.
2. You cut mixing time in half or better.
3. You get maximum color values from a minimum of color.
4. You do the entire job in ONE machine, over the entire range of your color card.
5. You fill directly from the mixer (or pump) to storage.
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200th Anniversary. William Post opened a "color shop" in 1754, on Lower Manhattan, and thus laid the foundation for the business structure which has grown in 200 years to be Devoe & Raynolds. (APJ-38)

**46.1.16.** De Soto Paint & Varnish Co. of Garland, Texas, has announced the completion of its new up-to-date resin plant. This new addition furthering the expansion of De Soto, which in 1953 completed its multi-million dollar "ultra-modern" plant at Garland, adds up to what is considered the finest and most modern paint operation in the country. (POCR-20)

**46.1.17.** Ashley, discussing equipment for latex paint manufacture, covers raw materials handling, forming the protective colloid, dispersing the pigment, blending & testing, and filling. (POCR-22)

**46.1.18.** Fair discusses how job enthusiasm means more work from employees. It is not easy to replace a well-trained man, and the author reviews the best methods to prevent the loss of good men. (APJ-70)

**46.1.19.** The Seidlitz Paint & Varnish Company has completed the installation of a modern and completely equipped resin plant. Since March 1 of this year (1954) all alkyd resins and other synthetic resins used in the firm's trade sales and industrial finishes have been manufactured by the company in its new "push-button" plant. (APJ-71)

**46.1.20.** 1953 marked the 100th year of continuous service to Kentuckiana industry by the Edw. H. Marcus Paint Company. Family-owned and operated, the company is going stronger than ever today because of its quality products and its service to customers. (PIM-6)

**46.1.21.** Devoe & Raynolds Company, Inc., America's First Paintmaker celebrates its 200th anniversary. President W. C. Dabney believes that the future of the company is more important than the past. That is why they plan to celebrate the start of their third century by stepped-up sales efforts. (PIM-12)

**46.1.22.** Woodruff describes a technique certain progressive manufacturers are starting to use with a view toward accurate prediction of production costs for competitive pricing. At the present time, and in the next years ahead, low production costs for paint will weigh equal in importance with high volume production. (PIM-16)

cf: 21.2.6
40.1.5

### Mixing & Agitation

**46.2.1.** Rushton reviews the field of mixing during 1953. Phases covered include general and review papers, mass transfer and turbulence, gas-liquid operations, viscous liquids, heat transfer, and continuous flow systems. (IEC-34)

**46.2.2.** To obtain both a stable emulsion and good heat transfer the single—bladed type of stirrer is the most efficient, according to Magnusson, who has conducted a series of experiments with laboratory apparatus. When the attainment of both these objectives is not essential other types of stirrer may be used successfully with less expenditure of power. (PM-51)

**46.2.3.** Weber discusses the use of draft tubes to increase mixing efficiency. These tubes define flow through a continuous mixing vessel, preventing short circuiting; they increase the effective scope of the mixing element; accentuate the direct mechanical shearing action of the mixing element upon the mix; amplify mixing action by effectively increasing the ratio of mixer diameter to container diameter. Draft tubes reduce the required shaft diameter and length, while ensuring complete turnover of the batch and they curtail or eliminate the use of submerged or interval guide bearing assemblies. (CE-1)

**46.2.4.** Quillen presents a 48-page report on mixing. Divided into 6 parts it includes mixing fundamentals, liquid mixing, paste mixing, plastics mixing, solids mixing, and continuous mixing. (CE-20)

**46.2.5.** Hightower discusses the use of ultrasonics in paint technology. Among the uses of ultrasonics are:

dispersion of solids in liquids
emulsification, liquid—liquid
emulsion polymerization
solutions reactors
destroying bacteria
electrochemical processes
cleaning metals
degassing solutions
(APJ-49)

**46.2.6.** The process of mixing within and discharging from a common mixing chamber a luminescent coating composition including, as ingredients, predetermined quantities of a suspension of luminescent material and a silicate solution, and water, which process comprises the steps of: establishing a flow of each of said ingredients into said mixing chamber and regulating the flow of each of said ingredients to an assigned preselected value; discharging the admixture from said mixing chamber in timed relation to the influx of said ingredients; selectively terminating the flow of said suspension of luminescent material and of said silicate solution into said mixing chamber to obtain said predetermined quantities thereof while continuing the influx of water to flush said chamber; anb thereafter terminating the discharge from said mixing chamder filled with water and effectively preventing entry of air thereinto. (USP-25)

**46.2.7.** The Rapids Machinery Co. (Marion, Iowa) is adding another industrial model to its line of Marion mixers. The new model is aimed at handling wet or dry chemicals, is available in ton and ton-and-a-half sizes. A 2 ton model, for handling dry material only, is also available.

cf: 46.1.8
46.1.11
Manufacturers:
Abbe Engineering Co.
Paul O. Abbe, Inc.
Alsop Engineering Corp.
Conn & Company
Eastern Industries Inc.
Hermas Machine Co., Inc.
Herman Hockmeyer & Company
Kent Machine Works
Mixing Equipment Co., Inc.
New England Tank & Tower Company
The Patterson-Kelley Co., Inc.
Read Standard Corp.
Charles Ross & Son Company
Troy Engine & Machine Company
Turbo-Mixer

### Grinding

**46.3.1.** O'Neill & Fremgen present a study of the optimum conditions for pebble mill dispersions in Pliolite S-5 systems. The major conclusions are as follows:

1. Pliolite S-5, although considered non-polar is as efficient in deflocculating pigments as the more polar resins, and consequently op-

PAINT MANUFACTURERS!
CUT GRINDING COSTS AND AVOID DISCOLORATION
with PENNEBACKER NI-HARD BALLS
(left) One Half of a Ni-Hard ball mounted in lucite, ground and polished to mirror finish to demonstrate soundness of structure. (right) Typical ¾" Ni-Hard grinding ball.
A charge of ¾" Ni-Hard balls after 5 months of paint grinding service.

**Ni-Hard,** the nickel-chromium iron which has successfully demonstrated its resistance to abrasion in the milling of both metallic and non-metallic minerals, is now available at moderate cost to the Paint Industry in the form of grinding balls.

The high hardness and wear-resistance of Ni-Hard means longer service life in the grinding of pigments, hence higher production and ultimate economy.

Moreover, discoloration is minimized when Ni-Hard balls are used. Paint manufacturers have found that pastel pigments can be safely ground with Ni-Hard balls where previously flint pebbles had to be used to avoid discoloration which occurred with steel balls. Naturally also, the greater density of the metal ball makes a substantial contribution to mill efficiency as compared with the use of the lighter pebbles.

## FIELD PROVEN SUPERIORITY:

1. On ¾" diameter balls grinding magnesium silicate in mineral oil, Ni-Hard showed an approximately 2 to 1 superiority over two types of high carbon steel as follows:

| BALL MATERIAL | % WEIGHT LOSS IN 5,000 HOURS |
|---|---|
| Ni-Hard | 5.52 |
| Steel A | 11.35 |
| Steel B | 12.95 |

2. A midwestern paint plant using ⅞" balls reported the following results:

| BALL MATERIAL | WT. LOSS (LBS.) IN 2,500 HOURS |
|---|---|
| Ni-Hard | 103 |
| Steel | 182–202 |

3. A Pennsylvania paint plant has used ⅞" Ni-Hard balls in regular grinding mill service for four years with excellent results both as regards economy and avoidance of discoloration problems.

Numerous paint manufacturers have now regularly adopted Ni-Hard balls. Interim reports indicate an increasingly wider acceptance of this efficient yet moderate priced modern grinding medium throughout the Paint Industry.

- Pennebacker Ni-Hard balls are available in four sizes: ⅝", ¾", ⅞" and 1" diameters.
- Delivery: Immediate, in bags or drums. All balls supplied in the *stress-relieved condition* to assure the maximum combination of abrasion-resistance and toughness.

**THE PENNEBACKER COMPANY, EMMAUS, PA.**

timum paste compositions are obtained.

2. Increased deflocculation is obtained by the use of solvent systems of lower surface tension.

3. The optimum pebble loads for pebble mills dispersions in Pliolite S-5 systems at conventional mill speeds is, 37% by volume pebbles of the total mill capacity.

4. The optimum paste charge for the pebble mills for Pliolite S-5 systems is either 100% of the void volume, or 66% of void volume, depending upon rheological characteristics of the flow point pastes. A method for making this choice has been developed. (OD-3)

**46.3.2.** A scientific approach to maintenance of steel ball mills and pebble mills is not new. New techniques developed help predict future trouble in mills. These methods now make a type of protective maintenance not previously possible. Maintenance problems in mills generally arise in a chronological order and are often related. This article outlines the protective maintenance for mills. (PVP-38)

**46.3.3.** Taylor discusses the factors affecting dispersion and the influence of those factors upon end-product characteristics. Included are: preparation of premix, oil absorption relationship, choice of viscosity, controlling the type of flow, used vs. new stones, proper choice of grit size, formulating for effect, stone clearances, and baking enamels. (OD-46)

**46.3.4.** Orwig presents a procedure for preparing ball mill dispersions in minutes instead of hours. Enough paste for up to a quart of reduced product can be made in the laboratory using simple and inexpensive equipment, most of which many paint laboratories already have. The results are spectacular by conventional lab mill standards. The procedure is quiet, clean-up is easy and fast, and correlation with production mills is excellent. (OD-62)

**46.3.5.** Hoback discusses theory and practice of pigment dispersion. The author has included an introduction; discusses the nature of the pigment and the nature of the vehicle. Both the process for producing the uniform distribution of materials and the composition itself have been designated by the term "dispersion." It is the purpose of this paper to discuss both connotations, with particular reference to pigment applications. (APJ-76)

**46.3.6.** Hoback continues the discussion of theory and practice of pigment dispersion. This second part considers the dispersion process & mixer-roller mill dispersion procedure. (APJ-78)

**46.3.7.** Is your roller mill doing the job? The quality of your paint dispersion depends on the proper roller mill being put to most efficient use. In this two-part article, Hoffman offers some advice. (CPVM-32)

**46.3.8.** Hoffman presents part II of his article on roller mill operations. The author gives advice on getting more efficient use of the roller mill to get better paint dispersion. (CPVM-38)

**46.3.9.** Thornton reviews the methods of dispersion. The author illustrates the effect of dispersion on gloss and color development, and discusses the stone mill, roller mills, mixer (such as dough mixer), and ball and pebble mills. (APJ-41)

**46.3.10.** Paul O. Abbe, Inc. has issued 32-page "Handbook of Ball and Pebble Mill Operation". Including 5 Chapters, it covers types of mills and linings, principles of grinding, good mill procedures, controls for better grinding, and questionnaire forms for seeking advice and prices.

cf: 46.1.8
46.1.11
Manufacturers:
Abbe Engineering Co.
Paul O. Abbe, Inc.
Cartrite International, Inc.
Chemicolloid Labs., Inc.
Hardinge Company, Inc.
Kenetic Dispersion Corp.
Kent Machine Works
J. M. Lehmann Company, Inc.
C. W. Logeman Company
LZP Industrial Ceramics
McDanel Refractory Porcelain Company
Manton-Gaulin Mfg. Company, Inc.
Marco Company, Inc.
Morehouse Industries
The Pennebacker Company
Pulverizing Machinery Company
Charles Ross & Son Company
Tri-Homo Corporation
Troy Engine & Machine Company
U. S. Stoneware Co.

### Thinning & Tinting

**46.4.1.** Beakes discusses the various points to consider in tinting. Many factors, from light conditions to the vagaries of eyesight, can affect the final color. (CPVM-15)

### Straining & Clarifying

**46.5.** (No abstracts)

cf: 46.1.11
Manufacturers:
Alsop Engineering Corp.
The Cuno Engineering Corp.
Industrial Filter & Pump Mfg. Co.
Sparkler Mfg. Company
D. R. Sperry & Company

### Packaging & Labeling

**46.6.1.** Hammond describes the development of the collapsible tube as a pack for paints and allied materials, and gives some advice on the choice of tubes. (PM-27)

**46.6.2.** Ford presents a review of aerosol paints and lacquers. He discusses nomenclature, industrial development of aerosols, propellents, formulation problems, application problems, packing, uses of aerosol paints, and aerosol paint remover. (PT-3)

**46.6.3.** Lueck, et al, discuss metal cans of the future. Tinless cans of the future are expected to come from a number of metals now under investigation and available on this continent, including untinned steel, specially treated steel, aluminum, and steel coated with aluminum, zinc and possibly nickel. (APJ-58)

**46.6.4.** Fein Tin Can factory in Brooklyn carries practically a full line of tin cans and steel pails for the ink and paint packing industries. The major portion of Fein's business comes from Metropolitan New York, New Jersey and Philadelphia. However, they do supply cans and pails to nearly every state in the country. (PIM-1)

**46.6.5.** Wright discusses the labeling of a self-service product (such as paint) successfully. A 33 question check-list for labeling is included. (PIM-7)

**46.6.6.** A sealed paint can having a cover and being partially filled with a paint vehicle, said cover being formed with a central depression and a concentric internally threaded central opening smaller in diameter than said depression, a pigment container partially threaded into said central opening, a rim on said pigment container equal in thickness to the depth of the cover depression, said pigment container being adapted to be manually turned into the screw threaded opening, and a cutting blade riveted to the underside of said cover and engaging the

side of said pigment container during the threading operation to spirally cut said pigment container throughout its entire length to expose the entire contents of the pigment container to the paint vehicle, the rim of said pigment container being seated wholly within the cover depression when said pigment container is completely threaded into said opening, presenting a substantially smooth and level cover. (USP-121)

**46.6.7.** The Steel Shipping Container Institute, Inc. has issued 30-page 1953-1954 Directory. The Institute's 35 members and the types of containers they manufacture, are listed. Steel shipping container specifications are listed, and industry history and statistics are reviewed.

**46.6.8.** A double-wall polyethylene liner for fiber or steel drums is available in 15-, 30- and 55-gal. sizes. Maker claims increased strength (over single wall) provides added protection. Offered by Mehl Mfg. Co., division Sydney-Thomas Corp., Cincinnati 2, O.

**46.6.9.** The Filler Machine Co. has a new semi-automatic filling machine that's said to be capable of handling products up to the viscosity of putty. It works on all size tubes, cans or glass containers, can fill a 5 gal. can with one stroke. The filler is constructed of bronze and steel but for corrosive applications, contact parts can be had in stainless.

cf: 46.1.11
Manufacturers:
American Can Co.
Beacon Printing Company. Inc.
Bennett Industries, Inc.
Bowser, Inc.
Burt Machine Company
Continental Can Co.
Crown Cork & Seal Co.
Davies Can Co.
Elgin Mfg. Co.
Fein's Tin Can Co., Inc.
Geuder, Paeschke & Frey Company
The Hopkins Company
Inland Steel Company
National Can Corp.
Popper & Sons, Inc.
The Pormix Corporation
U. S. Steel Products
Vulcan Stamping & Mfg. Company
Vulcan Steel Container Co.
F. H. Wiessner, Inc.

### Quality Control

**46.7.1.** Shatkin discusses quality control in the paint industry. Quality control is an important tool of management, and if buyer good will is to be achieved, quality control must be consistently maintained. No definite statistical quality control program exists in the paint industry today. The companies that do have any quality control programs are the raw material manufacturers.

The human element is very important. Inspection as such does not improve quality but merely separates the acceptable from the non-acceptable. Quality control attempts to prevent the manufacture of unacceptable items. Essentially quality control is a three step procedure—inspection, analysis and action. (PVP-13)

**46.7.2.** Shatkin presents part II on quality control in the paint industry. The quality control program begins with the raw materials used in the protective coating industry. In the paint industry, the quality of the raw materials used is one of the most important factors in determining the quality of the final product. This article deals with specifications for and acceptance of raw materials. (PVP-17)

**46.7.3.** In this third and concluding article by Shatkin on quality control in the paint industry, the author discusses the control of raw materials and finished products. The various tests on pigments, oils, thinners, etc. are discussed. (PVP-21)

**46.7.4.** Gaarder gives some practical rules for factory testing of protective coatings. These are:

1. Only those tests the product was designed to meet should be made on the product.
2. All tests for specific properties should be run under as nearly identical conditions as possible.
3. The very climatic conditions under which tests are conducted may have a great bearing on results.
4. Accept the limitations of apparatus and do not depend entirely on it for advice.

(OF-7)

**46.7.5.** McKay discusses the selection of the right laboratory furniture. Custombuilt furniture is not very expensive. The purchaser should specify and insist on quality to get the desired service. When buying laboratory furniture, buy from a reputable supplier and allow him to recommend what is good. (CPVM-6)

**46.7.6.** Huey discusses finished product control. This has been used for thousands of years, but the methods are different now. It can be a very simple thing or it can be very elaborate, using the combined talents of many people.

An effective system of finished product control can be maintained if we have good testing procedures, reliable standards, accurate and correctly calibrated instruments, good work and well-kept records. (APJ-60)

**46.7.7.** Gohman discusses product control of industrial finishes. All the efforts of the development laboratory are over-shadowed if the customer is allowed to receive an inferior product in the first, sixth, or any subsequent shipment. (APJ-62)

cf: 46.1.11

### Fume Control

**46.8.1.** Selheimer & Bauman present the development and use of two procedures for the analysis of fumes from paint and varnish manufacturing processes. The first procedure was developed for the separation of compounds, present in a fume sample, into solubility classes. The other procedure was developed to yield data from which the effectiveness and cost of the common fume disposal system can be evaluated for any given process. (OD-50)

**46.8.2.** Selheimer, et al, report on tests on analysis of fumes by selection adsorption. The sampling apparatus was tested on three different processes: tall oil-glycerine, linseed oil bodying, and castor oil-tall oil dehydration. Fume sampling runs were made on each of the three processes on a full scale plant basis, while small scale laboratory runs were made on the tall oil-glycerine and linseed oil bodying processes. The plant and laboratory runs were compared on a basis of peak fume load and material condensed. A preliminary separation was performed on material condensed in the dry ice trap from a tall oil-glycerine run using selective adsorption and results indicate feasibility of this method. (OD-51)

**46.8.3.** A preliminary study, by Selheimer, et al, was made to determine the feasibility of using activated carbon in conjunction

with other fume removal equipment to treat the fumes from esterification of tall oil with glycerine.

Objective was to determine whether activated carbon would remove the unpleasant odors from such a gas stream and if the cost of such an operation was within reasonable limits. Experiments were made on laboratory scale, utilizing sampling apparatus previously described in conjunction with an activated carbon adsorbent unit. (OD-52)

**46.8.4.** Selheimer, et al, tested four types of activated carbon to saturation point or break-through of fumes from esterification of tall oil with glycerine. Equipment was modified from previous work so that fumes passed successively through reflux condenser, water cooled condenser with trap, water scrubber, and finally through a carbon tower. Data were obtained concerning saturation values of the various carbons. From this, cost figures were calculated in terms of pounds oil/pound carbon and cost per 12,000 pound factory batch. (OD-53)

**46.8.5.** Selheimer & Borchers present a preliminary investigation on laboratory scale to determine the effectiveness of ozone as a deodorizing agent for fumes from the tall oil-glycerine esterification. Fumes from the reaction, after passing successively through an air cooled condenser (reflux), water cooled condenser, and water scrubber, were mixed in a chamber with ozone laden air. The ozone, generated by an ultraviolet lamp, at the rate of 0.2 grams per hour was found capable of deodorizing the fumes from this reaction up to kettle batch size of 700 grams total. (OD-54)

**46.8.6.** Selheimer, et al, studied the pilot plant scale operation of the method reported in 46.8.5. The economics of this operation are covered to the extent of the data. Cost of such treatment is very high compared to other methods. (OD-55)

**46.8.7.** Previous work had shown the possibility of separating the dry ice condensate fraction of fumes from the tall oil-glycerine esterification by chromatographic methods. Selheimer, et al, attempted to extend the method to the analyses of all the condensate fractions from the same reaction. It was shown that a system of chromatography that works for one type of materials does not necessarily work on other types; special techniques must be developed in each case. (OD-56)

**46.8.8.** Selheimer, et al, studied the catalytic combustion of fumes from tall oil-glycerine esterification. Fumes generated in a pilot plant size unit, were passed through a portable catalytic combustion unit. Results indicate the unit was capable of considerable odor reduction, but discharged gases were very irritating to eyes and nose. Apparently sulfur compounds in the gas stream were converted to oxides; unit not recommended.

A 223-reference bibliography covering articles on catalytic oxidation, from 1907 to 1952 is included, (OD-57)

**46.8.9.** Selheimer, et al, present an evaluation of a Schneible Multi-Wash Collector in suppression of paint industry fumes. It is concerned chiefly with performance, construction, operational details, maintenance costs, means of increasing performance, and safety of operation of the unit. Performance is defined as the ratio of the fume concentration decrease effected by the equipment over the fume concentration of the raw fumes expressed as per cent. Fume concentration is defined as pounds of condensable fumes per cubic foot of carrier gas passing uncondensed through cooling tubes in a dry ice-acetone bath. (OD-58)

**46.8.10.** Selheimer & Lance present an analysis by infrared spectroscopy of the fumes leaving resin reaction kettles and fume abatement equipment employed in the paint and varnish industry. In addition, the paper includes analyses of the fumes by mass spectroscopy, the evaluation of the catalytic combustion unit, the methods of generating fumes in the laboratory, and investigations into analyzing the fumes produced by reactions by employing both chromatography and infrared spectroscopy. (OD-59)

**46.8.11.** Selheimer, et al, present a general bibliography of fume control in the paint and varnish industry covering the period from 1919 through 1952. 239 references are included. (OD-60)

**46.8.12.** The problem of air pollution which plagues the paint and varnish industry may be licked by a new device—oxycat, an oxidizing catalyst, invented by L. J. Houdry, noted pioneer in the catalytic cracking of petroleum. This catalyst burns waste hydrocarbon vapors and gases to an odorless, non-inflammable exhaust of carbon dioxide and water vapor. (POCR-23)

Manufacturers:
Pangborn Co.
Claude B. Schneible Company
Schutte & Koerting Company

## CHAPTER 47

# MATERIALS HANDLING

### General

**47.1.1.** Speaker discusses automation in materials handling. Article includes engineered systems, conveyor systems, fork trucks, pallets monorail, systems, bulk storage, theory and training. (IEC-33)

**47.1.2.** Beskine presents the first of a series of articles on solving materials handling problems in medium-sized paint factories. There are numerous paint-making factories which are thinking about the installation of new or additional mechanical handling equipment. In general, one should think in terms of materials handling improvement, and this does not necessarily imply the purchase of merchanised equipment. This article aims at explaining the correct approach to materials handling improvement and the selection of mechanical handling equipment, should this prove necessary. It is addressed primarily to the smaller and the medium-sized paint, ink and varnish making factories. (PM-5)

**47.1.3.** Beskine presents part two on solving materials handling problems in medium-sized paint factories. Covered are selection of equipment, range of equipment employed, raw materials handling, handling tanks and kettles, containers and drums, finished goods storage, ending with hints and suggestions. (PM-10)

**47.1.4.** Use of a "Tri-Rotor" pump has proved satisfactory for pumping hot varnish. It is claimed 1) there is no squeezing or kneading of the product and a minimum of pulsation, 2) there is no cavitation, 3) the long shaft housing has eliminated leakage, 4) the suction remains excellent, and 5) this unit has operated for six years without a breakdown for repairs. (PVP-39)

**47.1.5.** Hudson discusses the use of pneumatic conveyors. They are versatile, safe and convenient. They are dustless and often lower in capital cost than other types. Hence their higher power cost may be of secondary importance. (CE-16)

**47.1.6.** Strube reports on conveyors and elevators. These can be classified as follows:

Conveyors—1. Belt
- a. troughed
- b. flat

2. Screw
- a. helicoid
- b. sectional
- c. ribbon
- d. cut flight
- e. mixing flight

3. Apron
- a. overlapping steel pans
- b. hinged steel pans

4. Scraper or chain and flight
- a. single strand of chain
- b. double strand of chain

5. Oscillating or vibrating
- a. mechanical
- b. electrical

6. Mass flow

7. Chain drag

Elevators — 1. Bucket type
- a. Centrifugal discharge or spaced bucket on either chain or belt
- b. Continuous bucket—slow speed—on either chain or belt
- c. Positive discharge—medium speed—on chain
- d. Gravity discharge
- e. Pivoted bucket

2. Mass flow type
- a. Solid flight
- b. Redler flight
- c. Tubular scrapper
- d. Tubular zipper

3. Screw or rotor-lift

4. Inclined belt conveyor

5. Inclined scraper or flight conveyor

6. Inclined apron conveyor

These various types are discussed in detail. (CE-17)

**47.1.7.** Elledge describes the importance of material handling to industry. This is done by a series of 14 questions and answers covering all phases of material handling. An important source of information is the Material Handling Institute, Inc. (Pittsburgh). (PIM-25)

**47.1.8.** A pouring attachment for paint cans and the like comprising, in combination, a ring-shaped member of a size to be received within the rim of a paint can and lie in the plane thereof, said member having a segmental portion of its perimeter formed of a band of flexible radially expandible material, a pouring lip secured to said band and conforming to the curvature thereof and being arranged to extend upwardly and outwardly over the adjacent portion of the rim of a paint can in which the ring-shaped member is received, an elongated body secured at one end to the member in diametrically

*An Exclusive*

# FOSTER

***Development***

## *THE AUTOMATIC FILTER PRESS PUMP*

***SAVES***

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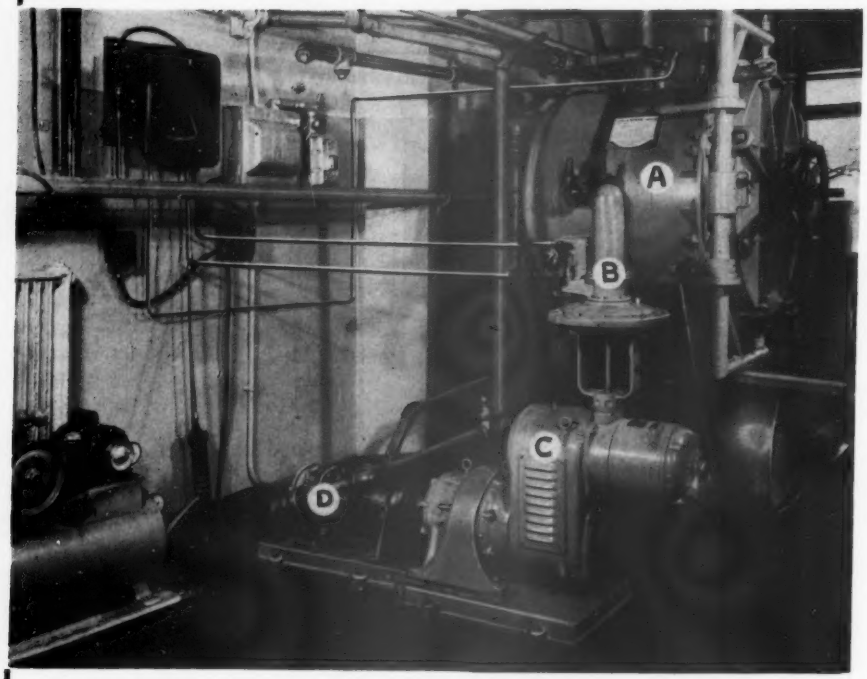


Filtering varnishes with automatic filter press pump: A - Filter Press, B - Pressure Regulator, C - Vari-Drive Gearmotor, D - Foster Rotary Pump. Black panel in upper left corner is Pressure Control.

- Automatically, the pump "watches" the pressure build up in the press as it "loads up."
- Automatically varies the capacity of the varnish being pumped to the exact maximum amount that the press can handle.
- Automatically and gradually cuts down the capacity of the varnish being pumped as the filter-press becomes more and more clogged.
- Automatically the pump stops when the filter-press just cannot filter any more varnish.

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FOR
FULL DETAILS!

**FOSTER PUMP WORKS, INC.**

52 WASHINGTON ST., BROOKLYN 1, N. Y.

ESTABLISHED 1860

opposite relation to the lip and extending radially outwardly from the member, said body lying in a plane offset upwardly from that of the ring-shaped member to overlie the rim of a paint can in which the latter is received and project outwardly therebeyond, a depending element carried by the body and shiftable into engagement with the rim of a paint can in which the ring-shaped member is received, and manually controlled means connected to said element and operable to cause the element to shift into engagement with the rim of the paint can and react therewith to expand said lip carrying portion of the ring-shaped member into sealing engagement with the rim. (USP-60)

**47.1.9.** The New Jersey Zinc Company has issued 8-page bulletin on Horse Head Unit Loads describing the handling of bags of pigments.

**47.1.10.** The Material Handling Institute, Inc. has issued 10-page booklet (#4 of the library of Know-How) on Material Handling—Organization, the Engineering and training.

cf: 46.1.6
46.1.11

Manufacturers:
The Elwell-Parker Electric Company
The Mercury Mfg. Company
Mitchell Industrial Tire Company, Inc.
Nutting Truck & Caster Company, Inc.
Stewart-Warner Corp.

### Pumping

**47.2.1.** Race presents a good philosophy to follow for watching pump safety factors. The intelligent application of pump safety factors will surely save you money, not only in equipment costs, but in your plant operations as well. (CE-3)

Manufacturers:
The Denison Engineering Company
Eco Engineering Company
Foster Pump Works, Inc.
General Ceramics Corp.
Goulds Pumps, Inc.
Industrial Filter & Pump Mfg. Company
Manton-Gaulin Mfg. Co., Inc.
Marlow Pumps
Naresco Equipment Corp.
The New York Air Brake Company
Schutte & Koertig Company

### Motors

**47.3.1.** First major revision of NEMA standards in 25 years takes advantages of new materials and engineering knowledge to make motors smaller for given ratings. (CE-4)

Manufacturers:
The Denison Engineering Company
General Electric Company
U. S. Electrical Motors Inc.
Westinghouse Electric Corp.

### Piping and Hoses

**47.4.1.** Olive presents a process piping primer. Process piping—not only the pipe itself, but also the valves, fittings, joints, and all the rest of it—is a subject close to the chemical engineer. It covers so much territory that many books could be written on it. For those who want a quick picture, here is a 24-page process piping primer including metallic piping components, pipe jointing methods, metallic valves, non-metallic piping systems and codes, standards and designs. (CE-7)

**47.4.2.** Muller reviews the advances in rubber hose and how they aid the paint industry. Types of hose, tube carcass etc., construction, material handling, couplings etc., are discussed. (PIM-31)

## CHAPTER 48

# SAFETY

### General

**48.1.1.** Jackson, et al, investigated the spontaneous combustion tendencies of paint vehicles. Twenty-four oils, alkyds and varnishes were studied.

The unbodied oils tested per se are more thermally reactive than those subjected to polymerization in the kettle or when incorporated into an alkyd or varnish. Drier has an influence on the spontaneous combustion tendency. The percentage of oil in either alkyds or varnishes has a very definite influence on the tendency of that vehicle towards spontaneous combustion; the higher the percentage of oil the greater this tendency toward thermal activity.

This study gives factual evidence that extreme care should be exercised in handling and disposing of all types of paint plant waste from a fire hazard point of view. (OD-7)

**48.1.2.** Opp, et al, consider the various aspects of combatting and conquering fire. A number of demonstrations relating to fire are presented. The problem of treating laboratory clothing to render them fire resistant is discussed. (OD-14)

**48.1.3.** Fire-fighting equipment manufactured by the National Fire Protection Co. Ltd. (England) was recently demonstrated at their factory. Two classes of equipment were shown: hand operated and permanent piped installations (automatic and/or remote controlled). (PT-4)

**48.1.4.** Connelly discusses fire —where the hazards are, some typical fires and what caused them, what precautions to take to prevent fires, and what automatic and manual equipment to install to fight small fires. (IF-4)

**48.1.5.** Pardes discusses good housekeeping in the finishing department, written along general lines. The author has tried to avoid mentioning those obvious and time-honored rules which are an integral part of any finishing department. (IF-43)

**48.1.6.** Cooke describes automatic fire protection for production painting at the Carrier Corporation's Thompson Street plant (Syracuse). (IF-47)

**48.1.7.** In handling chemicals the best answer to the safety question is "be prepared." Industrial chemicals can be divided according to physical shape, ie: solids, liquids and gases. Each form presents its own peculiar handling problems, but the safety equipment required is much the same for them all. (CPVM-28)

**48.1.8.** Volz discusses ways of reducing maintenance accidents in the chemical industry. The very nature of his job makes the chemical plant maintenance man more prone to accidents. This article tells how to reduce the hazard. (CPVM-39)

cf: 37.4.2
46.1.6

Manufacturers:
The C. M. Kemp Mfg. Company
The Protestoseal Company

### Solvents

**48.2.1.** The Esso Standard Oil Company has issued 60-page booklet on the "Care and Handling of Petroleum Products."

cf: 34.1.3
48.1.3

# TEST METHODS

## CHAPTER 49

# PERFORMANCE TESTS

### General

**49.1.1.** Gorden attempts to clarify the philosophical approach that is most likely to yield the best results from a simulated service test. Before such a test can be set up the following three questions must be answered to determine what part environment plays. First, is the product predominantly dependent upon its own operation for good performance? Second, is the product predominantly dependent upon external sources for good performance? Third, is the product dependent upon both its own operation and its environment for good performance? Having determined the importance of environment on performance a better approach to simulated service testing can be taken. (ASTM-1)

**49.1.2.** Tour describes three accelerated corrosion tests for materials and finishes. These include the Alternate Condensation Test consisting of a turn-table upon which the samples to be tested are mounted, and two or more chambers through which the turn-table revolves so that the samples are alternately exposed to the atmospheric conditions of each. The second is the Tour Wear-Corrosion Tester. The third is the Aerated Sea Water Tester. Although simulated service tests cannot replace actual corrosion service tests, they are useful when corrosion resistance must be evaluated in a relatively short time. (MM-1)

**49.1.3.** Hyler reviews the various instrumental methods for testing organic finishes. Included are discussions of the following:

test panels used
wet film thickness
cryptometers
other aspects of film thickness
measuring film thickness with an electromagnet
permanent magnets to measure film thickness
thickness testing device incorporates oscillators
"indirect" magnetic measurement
individual batch identification
tests for viscosity
hardness testing
tests for adhesion
tests for wearing properties
tests based on light reflectivity
electron diffraction instruments
spectrophotometers and color-difference meters
tests for color fastness
accelerated weathering tests
moisture tests

(OF-8)

**49.1.4.** In the second of three parts, Hopkins & Smart, continue their discussion of new ideas on paint blistering. Phases covered in this second part include—type of paint coating, influence of primers, effect of back-priming, and special paints. (CPVM-2)

**49.1.5.** Hopkins and Smart conclude their discussion of new ideas on paint blistering. Phases covered in this third part include—effect of a vapor barrier, effect of ventilating the wall space, effects of condensible vapors other than water, and a discussion of other experiments. (CPVM-9)

**49.1.6.** More than a year has elapsed since the Hercules Powder Company set up a sales service laboratory for protective coatings. This article describes the operation and work in progress. (PVP-37)

**49.1.7.** Dunn presents data illustrating many of the effects of water on films and discusses the results. The moisture resistance of paint films is a complex subject. Water permeability, water sorption, water solubility, osmosis, swelling of paint films due to water, unequal swelling of the wood in two directions, thermal expansion, and water sorption of the individual components of the paint film are but some of the factors involved in affecting the physical properties of the paint film as adhesion, tensile strength, elongation and hardness.

It appears that bodied linseed oil, an alkyd, a vinyl, butadiene-styrene and polyvinyl acetate emulsions, a phenolic, an acrylic and chlorinated rubber, as clear vehicles, are moisture resistant and blister resistant. Porous films such as obtained with a high fixed pigment vehicle ratio are blister resistant and have very high water permeability. (OD-41)

**49.1.8.** Brightwell describes an instrument for measuring the chip resistance of paints. Paints under normal service conditions are subjected to blows by sharp small objects which produce chips, causing an unsightly appearance and serious corrosion in the exposed areas. This instrument will measure the relative chip resistance of paint systems. (ASTM-14)

**49.1.9** Bobalek & LeBras discuss film structure and coatings properties. They question whether it can be assumed that in paint testing we are able to manufacture reproducible films. The microscopic approach in the studying of paint films shows that considerable variability of film structure is the rule rather than the exception unless an impractical number of variables are controlled in

th field application of paints. La oratory evaluations should place le s emphasis on standardizing id al conditions of preparing paint fil s and should attempt to simula e field variables in a systematic m nner. (OD-65)

**49.1.10.** Wray describes thirty yrs' experience in testing alumi- n m paint performance. Des- cr ptions and illustrations are given of the results achieved with coat- ings of various kinds, including different formulations of alumi- num paint on steel and alumi- num bases at the Aluminum Lab- oratories' several testing stations. Advantages of proper surface prep- aration and application techniques are demonstrated by improved service life in both long and short time tests. Tests show relative merits of various primers and of aluminum paint as an intermediate coat. Methods of testing employed at Aluminum Laboratories are described and illustrated. (C-4)

**49.1.11.** Spraul discusses the testing of tank car linings. The corrosion problems associated with tank car shipments are different than those encountered with stationary tank storage. Additional corrosive conditions are introduced because of the frequent loading and unloading of the car. Another factor is that the unloading of cars often is not complete and when it is not, on the return trip serious corrosion can occur.

Conditions for the preferred use of protective coatings on the interior of the tank car are discussed along with life requirements. Corrosive factors such as dilution, aeration, liquid and vapor phase contact, presence of moisture, separation of phases and heat are discussed.

Long term tests would give the best estimate of the expected coating life, but frequently time requirements necessitate the use of short term accelerated studies. Various testing methods are discussed and an evaluation of their usefulness is given. In particular, a testing method incorporating partial immersion of a coated panel, aeration, humidity and heat is described and results given. Some data from actual tank car applications are presented. (C-12)

**49.1.12.** Goldstein reviews the testing of industrial finishes. He discusses allowing the coating to cure before testing, acid tests, knife scratch tests, uniform film thickness tests, and gives examples of how tests can be misleading. (IF-36)

**49.1.13.** Gottlieb reviews practical applications of radioiostopes in protective coatings. Following an introduction, the practical uses to study cause of failure, plasticizer behavior, surface studies and resin and drier mechanisms are discussed. The research potential and rules for research are discussed. (POCR-1)

**49.1.14.** Wirth and Machu present a study of the electro-osmotic examination of paint films. The first phase of this investigation deals with the experimental verification of the premise that electro-osmotic water transport from or to anodic areas plays a part in the corrosion phenomena. (POCR-17)

**49.1.15.** Mueller & Laehder discuss corrosion testing for a small plant. Adoption of a corrosion testing program, such as suggested here for a small chemical plant, will pay off in less expensive and more satisfactory materials for plant construction. (CE-2)

**49.1.16.** Hopkins & Smart present the concluding part of their paper on an experimental study of blistering paints on wood. A laboratory apparatus is described by means of which the tendency of a paint coating on wood to blister under any given circumstances can be determined. It is shown that there is little tendency to blistering unless a temperature difference exists between the inner face and the outer face of the wood. (APJ-1)

**49.1.17.** A paper presented by the Dallas Paint and Varnish Production Club at the joint meeting of the Dallas and Houston Paint and Varnish Production Clubs on April 18, 1953 discussed the factors influencing premature paint peeling, on wood primarily southern yellow pine. Some of the physical surface characteristics of the wood were discussed. Correlations of these properties with paint failure was mentioned. Some of the other factors effecting the failure, such as resin content and moisture were discussed.

The paint industry faces a long and arduous struggle in overcoming the paint peeling problem on southern yellow pine. (APJ-20)

**49.1.18.** Scofield, in Lecture XVI in the Third Ten-Year Practical Paint Course, sponsored by the New England Production Club, discusses testing and research. There isn't enough research in the paint industry. As far as adhesion is concerned, little is known. Also, more should be known about the behavior of plasticizers and the mechanics of pigment suspension. There is plenty of room for research in the Paint Industry. (APJ-22)

**49.1.19.** Chremisinoff and Gierdano describe an original humidity exposure cabinet. This inexperience cabinet was designed and used for over two years. (APJ-26)

**49.1.20.** Williams reviews sedimentation analysis and some related problems. With the development of the ultracentrifuge there was provided a group of methods for the determination of solute molecular weight and of distribution of molecular weights in proper solutions. (JPS-33)

**49.1.21.** Wirth & Machu continue their paper on the electro-osmotic examination of paint films. In this second part they discuss electrolytic conductance in diaphrams. (POCR-21)

**49.1.22.** The Corps of Engineers, knowing the vital importance of minimizing losses by corrosion and realizing that large economies can be effected by the proper use of paint materials, have consistently worked toward improvement in the use of protective coatings. For this reason, a central paint laboratory for Civil Works was established in the Rock Island District at Rock Island, Ill. (APJ-54)

**49.1.23.** An electromagnetic method of testing the adhesive qualities of coating materials comprising the steps of adding iron powder to the coating materials, then applying the coating materials to a body and permitting the coating materials to dry, then fastening the body to make it immobile, next arranging an electromagnet contiguous to the coating materials, whereby the magneto-motive force of the electromagnet exerts a pulling force upon the iron powder in

the coating materials, and measuring the current necessary to generate the magneto-motive force which pulls the coating material from said body as an index of the adhesive quality of the coatings. (USP-120)

**49.1.24.** The Gardner Laboratory, Inc. has issued 58-page catalog of testing instruments for the paint and other industries.

cf: 2.1.3
18.1.7
20.2.4
39.4.1
41.1.1
Manufacturers:
Conrad, Inc.
Gardner Laboratory Inc.

### Weathering

**49.2.1.** Smith and Stead contend that the light-fastness of a pigment has no significance and that it is only the light fastness of a pigmentation that can be measured and has any value. The wide differences in light fastness shown by using the same pigment at the same concentration in different media are described. The adoption of the Blue Wool Scale B.S. 1006 in conjunction with the International Geometric Grey Scale is strongly advocated. The factors to be defined in the assessment of the light fastness of a pigmentation are enumerated and discussed. (JOCCA-23)

**49.2.2.** Efficient as accelerated laboratory methods of evaluation may be, it is important that they be supplemented by natural exposure to the elements under various conditions before a wholly complete picture of their behavior may be obtained. One of the most popular areas in the United States where these tests are conducted is the southern part of Florida. In this article, DeNoon answers the question "Why South Florida Exposure Tests?". (OF-10)

cf: 8.6.2
8.6.3
8.6.4
39.3.2
50.4.1
Manufacturer:
Atlas Electric Devices Co., Inc.

### Scrub Resistance

**49.3.1.** A machine has been devised which can be used to test wash or scrub resistance of water paints. Four paints are tested at the same time and six tests can be carried out on each paint. The surface is rubbed at the rate of 50 x 6 in. strokes per minute with a 1 in. diameter nylon-coated head surmounted by a 2 kg. load, the paint film is kept soaked with 2 per cent "Lissapol N" solution. Paints showing no failure after 1 hour (3,000 rubs) are judged excellent for wash and scrub resistance and for the adhesion to the surface under test. (JOCCA-19)

### Moisture Permeability

**49.4.1.** Dunn discusses the moisture resistance of paint films. Most cases of unsatisfactory performance of exterior house paints can be traced to the accumulation of water in back of the paint film.

The purpose of this paper is to present data illustrating many of the effects of water on films and to discuss the results. (PIM-29)

cf: 2.1.1

### Hiding Power

**49.5.1.** Switzer presents a progress report in the development of a hiding power test method. Analysis of results obtained in cooperative testing of a proposed method for objective determination of hid power of paints (Kubelka-Munk two constant theory) shows high precision and reproducibility should be obtainable after modifications have been made. (ASTM-12)

**49.5.2.** Dunn, et al, report on the progress in the development in the technique of making hiding power determinations. A real improvement has been established. By instituting the wet film thickness measurements and the use of structural black and white plate glass for spreading uniform films, good hiding power determinations are obtained in approximately one fourth the time and amount of work previously required.

The authors feel that the results obtained with these changes have made the method more accurate and more readily duplicated amongst laboratories. These changes allow determinations of hiding power in the range of 800 to 900 square feet per gallon which could not be measured on cardboard hiding power charts. After 3 years work, it appears that this method will provide the means to determine hiding power over the broadest range of hiding power of any techniqu studied. These changes will b incorporated in the Federatio Method for determining hidin power. (OD-9)

**49.5.3.** Gardner discusses th question of how many squar feet per gallon. The article in cludes the following:

Price per gallon up—but les waste—less cost
Volume production—more pos sible savings in dollars
To paint automatically control are necessary
Percentage of inefficiency is sel dom known accurately
Uniform film thickness all over coated areas
Accurate measurements will tell true story
Efficiencies of 10% to 99%— high ones get more study
Sources of possible error in calculations. (IF-31)

cf: 22.1.1

### Flexibility & Elasticity

**49.6.1.** In any discussion of paint vehicle testing, no single test seems to stir up as much controversy as the Kauri Reduction (KR) Test. Adopted in the face of adverse comment when it was first proposed and still subject to current criticism, the KR Test has persisted for some 35 years as a well known and valuable test method. Patton discusses the many factors which affect a KR value and through such a discussion contributes to a better understanding of the KR Test, its interpretation, and its prediction.

An attempt has been made to break the test down into its components so that in any discussion of the faults or merits, we can all see clearly just what we are arguing about. From such a basis we should be better able to proceed in developing the best procedure that industry can devise for evaluating this most important property of paint film elasticity or flexibility. (OD-29)

Manufacturers:
Gardner Laboratory, Inc.
Univeral Aviation Equipment, Inc.

### Adhesion

**49.7.** (No abstracts)

Manufacturers:
Gardner Laboratory, Inc.
Universal Aviation Equipment, Inc.

## CHAPTER 50

# ANALYTICAL TESTS

### General

**50.1.1.** Hanson discusses some of the problems encountered in the course of research on drying oils and synthetic resins, the way in which they were tackled, and the results obtained. Included are ring analysis by graphical-statistical methods, the comparative analysis of some stand oils, analysis of some newer drying oils or their fatty acids, and measurement of unsaturation of some hydrocarbon resins. (JOCCA-25)

**50.1.2.** Carman points out that surface area measurements of paint pigments should play a much greater part in production control and in specifications. A simple air permeability apparatus is described for making this measurement. Theoretical reasons are given for regarding optical methods as completely untrustworthy in the size range relating to paint pigments. (JOCCA-26)

**50.1.3.** Smith and Stead describe preliminary work on the assessment of a new method for the determination of the oil absorption of pigments. The method involves the addition of pigment to oil on the automatic muller and it is claimed that results are nearer to the true oil absorption value besides being more reproducible than those obtained by the B.S. method. (JOCCA-28)

**50.1.4.** Kut describes a method for separating free polystyrene from styrene copolymer drying oil fatty acids and non-styrenated drying oil fatty acids. It is based on the precipitation of all the fatty acids as insoluble soaps from ethyl acetate, the polystyrene remaining in solution. The method is equally applicable to the separation of unsaponifiable material from ordinary non-modified drying oils. (PVP-18)

**50.1.5.** Heiberger reviews the use of isotopic and chromatographic techniques to protective coatings technology. The use of radioactive isotopes allows methods of analysis which are more than a trillion times more sensitive than chemical methods. Chromatography is a physical factionation procedure and, as such, is applicable to extensive resolution of complex mixtures. Furthermore, unlike chemical procedures, the substances being analyzed are not altered. (PVP-23)

**50.1.6.** Color matching in mass production is very important in modern finishing methods. For instance, in a car where the various parts are finished at different times with different batches of finishes, do the fenders, hood and body match? Modern finishing methods would not be possible if color matching in mass production were not possible. In an article on this subject, the practical aspects of this problem are discussed. A standard test panel sprayer unit is described and discussed. (PVP-35)

**50.1.7.** Studying a polymer is not just application testing, but a cycle of make, characterize, and break. Behind-the-scenes research involves not only application-testing of polymers, but also fundamental studies of methods of preparation and evaluation of intermediate products and degradation mechanisms. (CEN-5)

**50.1.8.** Hyler reviews the various instrumental methods for testing organic finishes. Included are discussions of the following:

test panels used
wet film thickness
cryptometers
other aspects of film thickness
measuring film thickness with an electromagnet
permanent magnets to measure film thickness
thickness testing device incorporates oscillators
"indirect" magnetic measurement
individual batch identification
tests for viscosity
hardness testing
tests for adhesion
tests for wearing properties
tests based on light reflectivity
electron diffraction instruments
spectrophotometers and color-difference meters
tests for color fastness
accelerated weathering tests
moisture tests

(OF-9)

**50.1.9.** Heiberger discusses the application of isotopic and chromatographic techniques to protective coatings technology. Extreme sensitivity and unique specificity are advantages which make these two ultramicrotechniques invaluable tools for scientific progress. (OD-34)

**50.1.10.** The absorptivity and reflectivity of a number of surface coatings have been studied by Magnusson in a series of tests which he describes in this article. The experiments also provide a method for the measurements of thin films of coatings. Particular attention is given to aluminum paints and to coatings prepared from a blown linseed oil. (PM-60)

**50.1.11.** The influence of science and technology in the paint manufacturing industry and the increased use of specifications which require uniformity of apparatus

for particular tests are reflected in the growth of firms to manufacture instruments particularly for the industry. The modern factory of Sheen Instruments Ltd., founded by Mr. E. E. Jelpke, is an example of this trend. (PM-67)

**50.1.12.** Weiss discusses the importance of analysis. He reviews how the activities of the Analytical Group at the Research Laboratories tie in with Interchemical's over-all interest. (IR-4)

**50.1.13.** Melalia, et al, present a paper dip method to measure wet gel strength of coagulant-dipped films. A strip of paper is dipped in the latex, removed, rinsed in water, and mounted on a special tensile testing machine designed for high elongation and low tensile. Elongation and tensile are measured at a standard rate of jaw separation of 20 inches per minute. (AC-9)

**50.1.14.** Eppler reports on the application of a capacitance sensitive bridge to the measurement of the eccentricity and average thickness of the polyethylene sheath on cables and the method of thickness calibration. (BSTJ-1)

**50.1.15.** Gillis & Kedem obtain an approximate solution for the nonlinear diffusion equation in which the coefficient of diffusion is a linear function of the concentration. Methods are developed for deducing the relevant parameters from experimental data and of constructing theoretical curves from these parameters. Results are illustrated by an example. (JPS-18)

**50.1.16.** Eppler uses electrical capacitance to measure the thickness of polyethylene extruded onto electrical cable. The equipment measures thickness of the polyethylene directly in thousandths of an inch. (MP-25)

**50.1.17.** Heiberger discusses isotopic and chromatographic techniques applied to protective coatings technology. Extreme sensitivity and unique specificity make isotopic and chromatographic ultramicrotechniques invaluable tools for scientific progress. (POCR-16)

**50.1.18.** Klens, et al, describe a field method for detecting mildew on paint. Based upon the large sampling carried out by laboratories and the high degree of correlation obtained, it is believed that this bleach test will be of assistance to the paint chemist and the field man in allowing him to determine at the side whether the paint discoloration is due to mildew or "inanimate dirt". (APJ-51)

**50.1.19.** Wampner describes a test for evaluating paint odors. With this simple test a paint formulator can determine the odor level of a paint as if it were drying on the wall. (CPVM-22)

**50.1.20.** The Gardner Laboratory, Inc. has issued 58-page catalog of testing instruments for the paint and other industries.

cf: 5.1.11
13.2.1
20.2.3
35.2.1
36.10.1
36.10.2
37.4.2
46.7.2
46.7.3

Manufacturers:
Charles E. Barker Company
Gardner Laboratory Inc.
Macbeth Corp. & Subsidiaries

### Optical

**50.2.1.** Campbell suggests that the "Test for the fastness to light of colored textiles" as worked out by the Society of Dyers and Colourists should be of interest to paint chemists as the estimation of the fastness to light of a coating is one step which has to be taken separately in assessing the weathering of the coating. (JOCCA-10)

**50.2.2.** Mills and Werner describe a method of reversed-phase partition chromatography for the examination of natural resins. Each natural resin gives a distinctive chromatogram characterized by the number, color, and $R_F$ values of the zones corresponding to the components separated. The method can be used for the identification of natural resins alone or when present mixed with oils as in varnishes and paint media. It has also proved a convenient method for following the course of the separation of the constituents of dammar when chromatographed on an alumina column. A few synthetic resins have also been examined. A system of reversed-phase partition chromatography on kieselguhr (rendered unwettable by treatment with dichlorodimethyl silane) has been adapted for the separation of the acidic constituents of resins. Acids differing in their degree of unsaturation can be separated. This method has been applied to the qualitative examination of rosin and certain modified rosin materials. (JOCCA-24)

**50.2.3.** Newell, et al, reviews glossmeter design and gloss standards. Modern glossmeters measure intensity of a reflected light beam, and are somewhat affected by color though this effect is not always measurable by the instrument.

Sharpness of Image gloss has not been successfully measured, though this property is of more importance than the other so-called types of gloss.

Power supplied must be carefully regulated to avoid effects of line voltage variation. Three methods of regulation are available—constant voltage transformers, vacuum tube circuits, and null circuits.

Photovoltaic photoelectric cells are generally used in glossmeter construction because they generate the output voltage with no external connections, or power input. Photoemissive vacuum tubes require external power, but have much greater sensitivity to all levels of illumination.

Polarized light to date has not been successfully applied to the measurement of gloss of organic coatings.

Diffusion Comparison in gloss measurement has not been found to be applicable except in very limited ranges of gloss, while reduction of incidence angle has been totally ineffective.

The use of metal or ceramic plates as master panels for plastic impressions is not feasible since uniform degradation of mirror gloss by various means cannot be achieved.

Baked phenolic vehicles carrying various amounts of inerts are successful as standards since any gloss range may be duplicated at will. (OD-6)

**50.2.4.** Beck reviews reflectance properties and measurements. Included are fundamental considerations, illumination, the reflectometer, the reflectance value, contrast ratio, infra-red reflectance, yellowing, and color control. (OF-15)

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2. The Macbeth Executive ... for supervisory use.
3. Macbeth-Munsell Disk ... color specification.
4. Macbeth Laboratory pH...
5. Macbeth Color Aptitud...

**MACBETH DAYLIGHTING**

*a subsidiary of the Macbeth Corp.*

**Newburgh, New York**

**50.2.5.** Coleman reviews nine types of optical instruments used in industry. Included are magnifiers, microscopes, metallographic equipment, contour projectors, spectrographs, refractometers, polarimeters, and opacimeters. (PE-1)

**50.2.6.** Arnold presents the optical evaluation of pigment, Part I; discussion and methods. A pigment has two essential properties: opacity and color. Both contribute to the hiding power of a paint, but by basically different mechanisms, and must therefore be separated for a fair evaluation. Color is by no means exclusive to pigments; its quantitive measurement (as tinting strength) is well developed. Color in paint requires opacity for its disclosure, which may be supplied in the same pigment or separately.

True opacity is entirely reflective. It is entirely unrelated to tinting strength, and thus knowledge of one does not confer knowledge of the other. In spite of its prime importance, the measurement of opacity has been little developed. A simple method is described for determining the opacity of a pigment detached from considerations of color. (JOCCA-40)

**50.2.7.** Arnold presents an evaluation of whites, yellows and bright reds, optically along the lines laid down in part I. The order of opacity of white pigments is in agreement with that commonly accepted. The most opaque yellows, on a weight basis, are the Hansa Yellows, but the Lead Chromes are far and away the most opaque on a cost-of-opacity basis.

Two very different types of bright red pigments are required for self-color red paints: a high-opacity permanent pigment whose cost is not of prime importance, and a high-opacity cheap pigment whose permanence is not of prime importance. Helio Reds are outstanding for the first purpose, but no cheap organic reds of high opacity appear to exist, and the second purpose can be answered only by molybdated chromes, tinted by relatively transparent bluish-red toners to offset the orange color. (JOCCA-41)

**50.2.8.** Beck reviews the measurement of gloss. It is not difficult to produce a scientific definition of gloss which will satisfy the physicist or the optical engineer. And it is not difficult to devise instruments which will measure gloss in accordance with the definition. But to correlate these measurements with what the human eye sees and the human brain coordinates has, up to the present time, proven impossible.

For 60 degree measurements, the ASTM has provided the following table:

| | |
|---|---|
| High Gloss: | 70 (and above) |
| Semi-or | |
| Medium Gloss: | 70-30 inclusive |
| Eggshell: | 30-6 inclusive |
| Eggshell to flat: | 6-2 inclusive |
| Flat: | 2 and under |

(OF-23)

**50.2.9.** Beck discusses the measurement of color, color standards, fundamentals of color, the Munsell Color System, the color Harmony Manual (based on the Ostwald System). Other color systems are discussed, covering color measured with the spectrophotometers, Hunter multipurpose reflectometer, and the Hunter color difference meter. (OF-27)

**50.2.10.** Judd discusses instruments for measuring gloss, hiding power, and color of paint films. After giving some definitions, the author covers general considerations, gloss and its measurement, hiding power and its measurement, and color and its measurement. 14 references cited. (APJ-56)

**50.2.11.** A paper by Vickerstaff and Walls on color matching is divided into two parts. The first part is a study of the effect of illumination intensity on the ease and accuracy of visual color matching. It is shown that in the range 14-300 ft. candles, intensity of illumination has no effect upon the acceptance or rejection of near matching patterns. The accuracy of assessment of very small color differences does however increase with increasing light intensity, but soon reaches a maximum value beyond which further light appears to have little or no effect. The optimum light intensity under the conditions of these experiments was about 80 ft. candles. In the second half of the paper, attempts have been made to measure small color differences between patterns in an objective way and to correlate the results with the verbal descriptions of the color differences by trained colorists. It is concluded that small color differences can be measured on a recording spectrophotometer fitted with a continuous integrating device with sufficient accuracy. The results converted into colorists nomenclature show excellent qualitative agreement with the visual assessments. (JOCCA-4)

**50.2.12.** Wright discusses the scientific description of surface colors in terms of (a) the C.I.E. colorimetric specification, (b) the color appearance as expressed by the variables used in color atlases, (c) the surface texture as revealed by polar curves of luminance, chromaticity and spectral reflection and (d) the surface texture as revealed by local variations in light reflection and by the spread of the light within the surface. The many different types of surface which exist are indicated by the variety of names in use to describe them; and their scientific analysis and classification appears to be of increasing scientific interest and commercial importance. (JOCCA-5)

**50.2.13.** The development, improvement and application of methods for measuring the basic optical properties of paint films necessitates a knowledge of the physical factors, viz., the reflection, absorption and transmission of light by films (the objective approach), and also of those factors which are involved in the personal appreciation of such properties in practice (the subjective approach).

This paper by Tilleard and Bullett is particularly concerned with the measurement of gloss, opacity and color, indicating the types of method and instruments at present available, the principles on which they are based, and their scope and limitations in use. (JOCCA-6)

**50.2.14.** Harrison summarizes the main conclusions resulting from an extended investigation into the gloss of paper surfaces. The bearing of these conclusions on the design of glossmeters for general and specialized purposes is discussed. (JOCCA-7)

**50.2.15.** The color produced by printing ink depends principally on its film thickness and the reflectance of the background, but also on several other factors. The

present methods in general use of evaluating the optical properties of these inks are considered inadequate. The diffuse reflectance curves of two inks laid down over several neutral backgrounds at a range of film thicknesses have been measured and are shown to follow certain patterns. From such curves the coefficients of absorption and scattering have been calculated for both inks by the application of the Kubelka-Munk equation.

Reflectances predicted from these data compare well with measured values and indicate that this relationship may be of practical use in the study of inks. (JOCCA-8)

cf: 5.2.5
21.1.1
22.3.2

Manufacturers:
Bauch & Lomb Optical Company
Fisher Scientific Company
Gardner Laboratory, Inc.
Macbeth Corp. & Subsidiaries
Ultrasonic Engineering Company

### Analysis For Content

**50.3.1.** Georgans gives details of conditions found suitable for a number of polarographic estimations, including maleic anhydride in phthalic anhydride, lead and cobalt metals in driers, copper in copper naphthenate, zinc and titanium in pigments, and aluminum in "metallic finishes".

The literature on polarography related directly to the paint industry is reviewed and references are given covering the examination of pigments, driers, plasticizers, phosphatizing baths and phosphate coatings, and of many organic and other compounds associated with surface coatings. The construction of a simple, inexpensive polarograph is described together with the elementary theory behind its operation. (JOCCA-21)

**50.3.2.** Hunt, et al, describes a method whereby the dielectric value of an oil extract can be converted to percentage of oil. The method appears to be quite suitable for the practical application to the rapid determination of the oil content of flaxseed. Results on a single sample can be obtained in about 20 minutes and the technique of analysis is simple enough so that non-chemists can, with brief instructions, perform the analysis with speed and accuracy. (JAOCS-4)

**50.3.3.** Martin & Lloyd present a simplified procedure for determination of water by the Karl Fischer Method as applied to dry-cleaning detergents and solvents. The procedure permits one to determine water in most systems to two significant figures. (JAOCS-7)

**50.3.4.** Rushman & Simpson describe a semi-micro molecular still for quantitative use. Molecular distillation is probably the most satisfactory method to determine the amounts of monomer, dimer, etc., in polymerized systems. The apparatus is essentially a microhotplate running in a high vacuum. (JOCCA-34)

**50.3.5.** Malm, et al, report on the determination of total and primary hydroxyl in cellulose esters by ultraviolet absorption methods. Ultraviolet absorption measurements have been used to measure quantitatively the amounts of carbanilate and of trityl introduced into hydrolyzed cellulose acetate by reaction with phenyl isocyanate and trityl chloride, respectively. Measurement of the carbanilate content allows calculation of the total hydroxyl, and measurement of the trityl content allows calculation of the primary hydroxyl in the original material. These methods have been applied to a wide variety of cellulose esters, and their precisions have been evaluated using a typical sample of cellulose acetate. (AC-6)

**50.3.6.** Shay, et al, separated the polyhydric alcohol fraction of a polyester resin by modified saponification procedure. The component alcohols are identified by infrared spectral analysis. The method provides an effective means of identification for individual polyhydric alcohols and for binary mixtures. (AC-7)

**50.3.7.** The diethyl esters of eight selected dicarboxylic acids were prepared and studied by Stafford, et al. Various physical properties were determined on the purified products. The potential applicability of these properties to the analysis of mixtures of esters was evaluated. (AC-8)

**50.3.8.** In a laboratory apparatus for the evaluation of constituents of oils under test, a furnace body, an inclined conduit through which oil under test is adapted to be passed extending through said body, heating coils surrounding said conduit, a specimen holder container in said conduit, and a specimen holder in said container, said specimen holder comprising a relatively thin, elongated, dished plate deformed to provide a supporting surface of relatively small contact area whereby said plate may be positioned above its supporting surface to permit air circulation there-about. (USP-97)

cf: 16.1.4
17.1.5
26.3.1
35.1.4
35.1.12
35.4.5

### Statistical Analysis

**50.4.1.** Touchin gives examples of statistical analysis of exposure data, illustrating that conclusions drawn from visual inspection of the data are not always justified, and some of the advantages to be gained by applying statistical methods. An example is included to illustrate the use of the correlation coefficient in relating accelerated and normal exposure methods. Finally a discussion of the limitations imposed by the normal methods of rating exposure panels is given. The use of discriminatory analysis to obtain a single value to designate durability is illustrated. (JOCCA-16)

**50.4.2.** Li describes a nomograph which makes it possible to determine quickly the significance of attributive test results on two samples of equal size. It is particularly valuable to such people as plant managers, purchasing agents, production engineers, quality-control men, and research workers. (ASTM-9)

**50.4.3.** Most statistical predictions made from measurements on samples are based on the assumption that the samples are random. By proper choice of the sampling conditions bias and nonrandomness can be minimized. Snyder, et al, describe a method for sampling paintbrush fibers. Experimental studies of samples taken by the method support the assumption that random samples are obtained. (ASTM-11)

**50.4.4.** Touchin, in the second of a series of articles dealing with application of statistical methods

to exposure trials, describes the design of exposure tests.

Following a brief discussion of the types and sources of errors inherent in exposure trials, descriptions are given of some standard experimental designs, illustrating how the influence of these errors upon the experimental results may be minimized by their use. The basic designs considered are randomized block, factorial and split plot designs which are all amenable to statistical analysis. Some discussion on the number of replicate panels and the use of controls follows. The combining of data from experiments conducted at different times and at different exposure stations is briefly mentioned. Finally, the general advantages to be obtained by using these procedures are presented. (JOCCA-30)

**50.4.5.** Bicking reviews the statistical methods in ASTM standards. It is noted that in ASTM the trend is toward adopting standard statistical clauses in material standards. A gradual change in the statistical content of most ASTM standards indicates that these standards are not dead but rather living, growing concepts. (ASTM-13)

**50.4.6.** Krigbaum reports accurate osmotic pressure measurements for fine polystyrene fractions, ranging in molecular weight from $5\times10^4$ to $2\times10^5$, in cyclohexane at 30, 40, and 50°. Evaluation of these data yields for the thermodynamic parameters $\Theta=307.6°K.$ and $\psi=0.36$. (JACS-66)

**50.4.7.** McArthur, et al, discuss the evaluation of test procedures. A method is presented for obtaining an estimate of reliability of a test method run by a number of different laboratories. It gives a working estimate of the reliability of the test method, and it indicates which laboratories, if any, are not qualified to run the test without improvements in their technique. (AC-13)

**50.4.8.** Pocock describes statistical quality control at the Ternstedt Division of General Motors at Detroit. This plant is one of the world's largest producers of automobile hardware. Much has been done on statistical quality control at this plant and they are justifiably proud of their applications of statistical quality control methods. (PF-2)

**50.4.9.** Woodell describes the application of statistical quality control to the control of plating solutions. (MF-2)

**50.4.10.** Kushner reviews statistical quality control methods and how they can be used to establish operating limits. (MF-4)

**50.4.11.** Statistical methods are being used more and more in the process industries. Chemical Engineers are finding them valuable for both research and production problems. (CE-5)

**50.4.12.** Proschan & Babcock present short-cut statistical techniques which give an objective analysis of engineering data—rapidly. (CE-25)

**50.4.13.** The known non-volatile contents of five media were determined by an oven-heating method employing two variants each of time (three and four hours) and temperature (110°C. and 130°C.). Twenty-four operators in different laboratories submitted nearly 1,000 results, which have been analyzed statistically in order to determine:-

1. the accuracy or variation from the known true value, and
2. the precision or reproducibility of the results.

The best of the methods examined, for accuracy and precision, is heating for four hours at 110°C. The largest error is that between operators. (JOCCA-11)

cf: 46.7.1

### Viscosity Measurement

**50.5.1.** Marshall describes the use of the parallel plate plastometer to study viscosity changes in thermosetting resins. Results obtained on several phenolic resins and a silicone resin are presented. (IEC-30)

**50.5.2.** Asbeck & Van Loo discuss pigment-binder high shear viscosity studies. Data obtained with high shear viscometers operating in the brushing range for paints provide opportunities to derive simple and interesting relationships not discernible from studies confined to low shear velocities.

The validity of the hypothetical term "residual viscosity at infinite shear velocity" in practical viscometry is demonstrated. At infinite shear velocity all structure has been eliminated and the viscosity of the system is dependent upon the viscosity of the liquid, pigment concentration, and pigment shape and size distribution.

Application of this concept to the equations derived by Vand & Brailey indicates close conformity with practical rheology of paint systems. The proportionality between the viscosity of a suspension at infinite shear velocity and the viscosity of the vehicle is shown. More work is required to make a comprehensive prediction of the influence of form factor and immobilization constant on the viscosity of pigmented systems. (IEC-60)

**50.5.3.** Peterlin reports on the viscosity and streaming birefringence in the nonlinear concentration range of macromolecule solutions. From the close correlation between viscosity increment and streaming birefringence in dilute solutions, the parallelity of both effects in concentrated solutions is deduced and proved by the results on nitrocellulose, polystyrene, and polyisobutylene samples. (JPS-23)

cf: 5.1.1
5.1.2
5.1.3
5.2.2

Manufacturers:
Brookfield Engineering Labs, Inc.
Gardner Laboratory, Inc.
General Electric Company
Ultrasonic Engineering Company
Universal Aviation Equipment, Inc.

### Electron Microscopy

**50.6.1.** Bobalek, et al, discuss the use of the electron microscope in the study of paint films. The usefulness of the electron microscope in the study (of paint films of ordinary thickness) has been extended greatly by the improvement of the silver-silica and polyvinyl alcohol-silica replica techniques. (IEC-45)

**50.6.2.** Swerdlow reviews electron microscopy for 1953. 188 references are cited. (AC-3)

cf: 5.1.1
5.1.3
5.1.4
5.2.2
5.2.3

### Density & Specific Gravity

**50.7.1.** Sims has determined the densities of triglyceride oils and their esters by the Falling Drop

Method to within ±0.0003 when the behavior of two drops were compared and to ±0.0002 when only one drop was employed. Triolein and methyl erucate have been used as reference materials and solutions of ethanol in water as media. Errors due to variation in temperature have been analyzed for the systems and apparatus employed. (JAOCS-21)

cf: 12.3.2
Manufacturer:
Gardner Laboratory, Inc.

### Particle Size

**50.8.1.** Corcoran discusses the determination of particle size. It is not possible to allot a single numerical measure to a given sample of a pigment; other factors must be considered. In this article are discussed the distribution function, effect of shape, equivalent diameter, experimental determination, sedimentation and elutriation. (PM-12)

**50.8.2.** In this second of two parts, Corcoran continues his discussion of the elutriation and sedimentation methods of particle size determination, the two best suited for paint raw materials. (PM-26)

cf: 19.6.1
Manufacturer:
Gardner Laboratory, Inc.

### Spectroscopy

**50.9.1.** Ahlers & O'Neill reviewed some of the outstanding problems of oil and resin chemistry and their technical significance, and went on to show how infra-red and ultraviolet spectroscopy were helping to solve problems. (PM-42)

**50.9.2.** Stamm reviews raman spectroscopy for 1953. 195 references are cited. (AC-4)

**50.9.3.** Meggers reviews emission spectroscopy for 1953. 147 references are cited. (AC-5)

Manufacturer:
The Perkin-Elmer Corp.

### Molecular Weight Determination

**50.10.1.** Bannister, et al, examined two new countercurrent methods as fractionating techniques in molecular weight distribution determinations. The initial experiments have been carried out on silicone polymers, known to be linear. Experiments using gradient elution, in which carbon was the adsorbent and the eluting solvent was ether in methanol, gave a series of fractions of the silicones, the molecular weight of the fraction increasing with effluent volume. A second method, liquid-liquid partition in a vortex column was successfully applied to fractionation of low molecular weight material. The methods allow rapid determination of the molecular weight distribution in silicones. The fractions obtained are sharp and will permit a fresh examination of much of the theory of high polymers. (AC-19)

**50.10.2.** Mock, et al, have designed a simple and inexpensive instrument for measuring the osmotic pressure of polymer solutions. A 1:3 copolymer of vinyltoluene and styrene monomers was separated into 24 cuts by fractional precipitation. On the basis of viscosity data these cuts were combined into 14 fractions. They were in the order of decreasing molecular weight, and infrared analysis indicated a uniform distribution of the ring methyl groups among fractions. It demonstrates that introduction of methyl groups into the benzene rings of a polystyrene molecule does not influence the polymer solubility appreciably. (JPS-10)

# GOVERNMENT SPECIFICATIONS

## CHAPTER 51

# SPECIFICATIONS

Sources:

An Index of Specifications is available from the
Superintendent of Documents
U. S. Government Printing Office
Division of Public Documents
Washington 25, D.C.

This index is composed of three parts as follows:

Index of Specifications and Standards (Used by) Dept. of the Army Military Index—Vol. II, Cat. No. D101.34:

Index of Specifications and Standards (Used by) Dept. of the Navy Military Index—Vol. III, Cat. No. D212.10:

Index of Specifications and Related Publications Used by U. S. Air Force Military Index—Vol. IV, Cat. No. D301.28:

Copies of Federal Specifications can be purchased from:

Superintendent of Documents
U. S. Govt. Printing Office
Division of Public Documents
Washington 25, D.C.

Copies of JAN and MIL Specifications are available from the individual custodian departments of the military as indicated below.

### Department of the Navy

| | |
|---|---|
| Bureau of Aeronautics | Chief, Bureau of Aeronautics<br>Technical Data Division<br>Room 1W06, Building "W"<br>Department of the Navy<br>Washington 25, D.C. |
| Marine Corps | Commandant, U. S. Marine Corps<br>Attn: Code CSG<br>Headquarters, U. S. Marine Corps<br>Washington 25, D.C. |
| Bureau of Medicine and Surgery | Armed Services Medical Procurement Agency<br>Attn: Navy Specifications Liaison Officer<br>84 Sands Street<br>Brooklyn 1, New York |
| Bureau of Ordnance | Chief, Bureau of Ordnance<br>Attn: Standards, Materials and Specifications Branch (Rec)<br>Department of the Navy<br>Washington 25, D.C. |
| Bureau of Naval Personnel | Chief of Naval Personnel<br>Attn: Pers-H212<br>Department of the Navy<br>Washington 25, D.C. |
| Bureau of Ships | Chief, Bureau of Ships<br>Attn: Purchase Specifications & Standards Branch<br>Code 357<br>Department of the Navy<br>Washington 25, D.C. |
| Bureau of Supplies and Accounts | Chief, Bureau of Supplies & Accounts<br>Attn: Code S-33, Arlington Annex<br>Department of the Navy<br>Washington 25, D.C. |
| Bureau of Yards and Docks | Chief, Bureau of Yards and Docks<br>Attn: Code C-330<br>Department of the Navy<br>Washington 25, D.C. |

### Department of the Army

| | |
|---|---|
| Chemical Corps | Commanding General<br>Chemical Corps Material Command<br>Attn: Industrial Division<br>200 West Baltimore Street<br>Baltimore 1, Maryland |
| Corps of Engineers | Chief of Engineers<br>Department of the Army<br>Attn: Administrative Service Division<br>Washington 25, D.C. |
| Army Medical Service | Chief, Armed Services Medical Procurement Agency<br>Attn: Material Standards Division<br>84 Sands Street<br>Brooklyn 1, New York |
| Ordnance Corps | Chief of Ordnance<br>Department of the Army<br>Washington 25, D.C. |
| Quatermaster Corps | Chief, Research and Development Labs.<br>Philadelphia Quartermaster Depot<br>Attn: Specifications Branch<br>2800 South 20th Street<br>Philadelphia 45, Pa. |
| Signal Corps | Commanding Officer<br>Signal Corps Supply Agency<br>225 South 18th Street<br>Philadelphia 3, Pa. |
| Transportation Corps | Chief, TC Supply Cataloging Agency<br>Marietta Transportation Corps Depot<br>Marietta, Pa. |

### Department of the Air Force

| | |
|---|---|
| Air Force | Commanding General<br>Wright Air Development Center<br>Attn: WCXSP<br>Wright-Patterson Air Force Base<br>Dayton, Ohio |

Departmental Specifications and Tentative Specifications are available from the issuing departments.

Copies of AN Aeronautical Specifications are available from either of the following sources:

Commanding Officer
U. S. Naval Air Station
Johnsville, Pa.

Commanding General
Wright Air Development Center
Attn: WCXSP
Wright-Patterson Air Force Base
Ohio

Copies of U. S. Coast Guard Specifications are available from:

The Commandant (FS-M)
U. S. Coast Guard
Washington 25, D.C.

## FEDERAL SPECIFICATIONS

C-[illegible]-191
Beeswax; Technical-Grade

O-[illegible]-51a, Amend. 2
Acetone

O-[illegible]-406 (Navy Ships)
Disinfectant, Germicide, and Fungicide

O-[illegible]-751
Ether; Petroleum

O-[illegible]-491, Amend. 2
Glycerin (Glycerol)

O-[illegible]-164
Leather Dressing; Mildew-Preventive

O-[illegible]-169
Leather Dressing, Transmission-Belt

O-M-232, Amend. 2
Methanol (Methyl Alcohol)

O-T-236, Amend. 1
Tetrachloroethylene (Perchlorethylene); Technical Grade

P-G-406
Glass Cleaner, Liquid

P-P-546
Polish; Automobile, Liquid

P-R-791(Navy Ships), Amend. 2
Rust Removing Compound (Phosphoric Acid Base) (For Use on Ferrous Metal Surfaces)

P-S-661a
Solvent; Dry-Cleaning

P-W-134
Wax, Floor; Solvent-Type, Liquid (With Resins)

P-W-141, Amend. 1
Wax, Floor; Liquid and Paste

P-W-158, Amend. 1
Wax, General-Purpose; Solvent-Type, Liquid and Paste (Floors, Furniture, Etc.)

U-L-51
Lacquer, Model

HH-C-536
Compound; Plumbing-Fixture-Setting

SS-A-128
Adhesive, Asphalt, Cut-Back Type (For Asphalt Tile)

SS-A-674b
Asphalt, Paving, Emulsion

SS-A-701
Asphalt-Primer; (For) Roofing and Waterproofing

SS-C-153
Cement; Bituminous, Plastic

SS-R-451
Roof-Coating; Asphalt, Brushing-Consistency

SS-S-156
Sealer; Cold-Application Emulsion Type, for Joints in Concrete

SS-S-159
Sealer; Cold-Application Mastic Type, for Joints in Concrete

SS-S-164
Sealer; Hot-Poured Type, for Joints in Concrete

TT-A-466, Amend. 1
Aluminum-Pigment-Paste; (for) Paint

TT-A-468a, Amend. 1
Aluminum-Pigment; Powder and Paste, for Paint

TT-A-476, Amend. 3
Aluminum-Powder; (for) Paints (Aluminum-Bronze-Powder)

TT-A-511
Amyl Acetate (For Use in Organic Coatings)

TT-A-516
Amyl Alcohol; Secondary (For Use in Organic Coatings)

TT-A-566b
Antimony Oxide, Dry (Paint Pigment)

TT-B-486, Amend. 2
Blue-Lead, Basic Sulphate, Dry and Paste-In-Oil

TT-B-600
Bone-Black; Dry (Paint-Pigment)

TT-B-601, Errata 1
Bone-Black; Dry, Paste-in-Japan, Paste-in-Oil

TT-B-838
Butyl Acetate; Normal (For Use in Organic Coatings)

TT-B-840
Butyl Acetate; Secondary (For Use in Organic Coatings)

TT-B-846
Butyl Alcohol; Normal (For Use in Organic Coatings)

TT-B-848
Butyl Alcohol; Secondary (For Use in Organic Coatings)

TT-C-83
Cadmium-Yellow (Calcium Lithopone); Dry (Paint-Pigment)

TT-C-96
Calcimine (Cold-and Hot-Water-Types)

TT-C-120, Amend. 1
Carbon-Black; Dry (Paint-Pigment)

TT-C-235, Amend. 2
Chrome-Green; Pure, Dry (Paint-Pigment)

TT-C-290, Amend. 2
Chrome-Yellow and Chrome-Orange; Dry (Paint Pigments)

TT-C-291
Chrome Yellow; Dry, Paste in Japan, Paste In Oil, (Lemon, Medium, Orange)

TT-C-306
Chromium-Oxide-Green; Dry (Paint-Pigment)

TT-C-520, Amend. 1
Coating, Underbody (For Motor Vehicles)

TT-C-591, Amend. 1
Colors; (for) American Flag

TT-C-598, Amend. 1
Compound, Calking; Plastic (For Masonry and other Structures)

TT-C-610, Amend. 1
Copper-Phthalocyanine-Blue; Dry (Paint-Pigment)

TT-C-621, Amend. 2
Correction-Compound; Stencil

TT-D-291
Diamyl-Phthalate; Plasticizer (For Use in Organic Coatings)

TT-D-301, Amend. 1
Dibutyl-Phthalate; Plasticizer (For Use in Organic Coatings)

TT-D-376a
Dipentene; For Use in Organic Coatings

TT-D-643b
Drier, Paint, Naphthenate, Liquid, Concentrated

TT-D-651b(Navy Ships)
Drier; Paint, Liquid

TT-E-485b, Amend. 2
Enamel; (for) Drums and Other Metal Products, Rust-Inhibiting, Olive Drab

TT-E-487
Enamel; Floor and Deck

TT-E-489a, Amend. 1
Enamel; Gloss, Synthetic (for Exterior and Interior Surfaces)

TT-E-491, Amend. 2
Enamel; Gloss, Synthetic (For Metal and Wood Hospital Furniture)

TT-E-496, Amend. 2
Enamel; Heat-Resisting (400°F.), Black

TT-E-0506b
Enamel; Interior, Gloss, Tints and White

TT-E-508, Amend. 4, & Notice 1
Enamel; Interior, Semigloss, Tints and White

TT-E-514, Amend. 1
Enamel; Lusterless, Olive-Drab (Primarily for non-military use)

TT-E-0543
Enamel-Undercoat, Interior, Tints and White

TT-E-751
Ethyl Acetate (For Use in Organic Coatings)

TT-E-776, Amend. 1
Ethylene Glycol Monobutyl Ether (For Use In Organic Coatings)

TT-F-336a
Filler; Wood, Paste

TT-I-511a
Indian-Red and Bright-Red (Iron-Oxide); Dry (Paint-Pigments)

TT-I-521, Amend. 1
Ink; Copying and Record

TT-I-525
Ink, Drawing; Liquid (Tusche), Lithographic

TT-I-528a
Ink; Drawing, Waterproof, Black

TT-I-531, Amend. 1
Ink; Drawing, Waterproof, Colored

TT-I-542a
Ink; Marking, Indelible, Black, for Fabrics

TT-I-545
Ink; Marking, Quick-Drying, for Photographic Film

TT-I-547
Ink; Numbering-Machine, for Photographic Negatives

TT-I-549a
Ink; Red, Writing

TT-I-554
Ink; Stamp-Pad, Red, for Photographic Prints

TT-I-556a
Ink; Stamp-Pad

TT-I-557
Ink; Stencil, Duplicating-Machine, Climate-proof, Black, Castor-Oil-Base

TT-I-558, Amend. 1
Ink, Stencil; Opaque, for Marking Non-Porous Surfaces (Metal, Glass, Etc.)

TT-I-559
Ink, Stencil; Opaque, for Marking Porous Surfaces (Wooden-Boxed, Fibre-Cartons, Etc.)

TT-I-561
Ink; Stencil, Duplicating-Machine, Climate-Proof, Black, Non-Castor-Oil-Base

TT-I-562
Ink, Writing, for Ball-Point Fountain Pen

TT-I-563b
Ink; Writing, Blue-Black, for Fountain, Dip, and Steel Pens

TT-I-566
Ink; Writing, Blue, Alkaline (Non Corrosive)

TT-I-677, Amend. 2
Iron-Blue; Dry (Paint-Pigment)

TT-I-698, Amend. 1
Iron Oxide; Black, Synthetic, Dry (Paint Pigment)

TT-I-702
Iron Oxide; Brown, Synthetic, Dry (Paint Pigment)

TT-I-721
Isopropyl Acetate (For Use in Organic Coatings)

TT-L-54
Lacquer; Spraying, Acid-Resistant (for Aluminum Surfaces Around Storage Batteries)

TT-L-58
Lacquer; Spraying, Clear and Pigmented (General-Use)

TT-L-70, Amend. 1.
Lampblack; Dry (Paint-Pigment)

TT-L-71, Amend. 3
Lampblack; Dry, Paste-in-Japan, Paste-in-Oil

TT-L-426
Lithopone; Dry (Paint-Pigment)

TT-M-90
Magnesium-Silicate; Dry (Paint-Pigment)

TT-M-251
Metallic-Brown; Dry (Paint-Pigment)

TT-M-261, Amend.2
Methyl-Ethyl-Ketone (For Use in Organic Coatings)

TT-M-381
Mineral-Red (Iron-Oxide), Natural; Dry (Paint-Pigments)

TT-N-95, Amend. 1
Naphtha; Petroleum, Aliphatic (For Use in Organic Coatings)

TT-N-97, Amend. 2
Naphtha; Petroleum, Aromatic (For Use in Organic Coatings)

TT-O-121
Ocher; Yellow, Dry (Paint-Pigment)

TT-O-356a
Oil; Flatting and Mixing (For Thinning White-Lead-Paste and Similar Paste Paints)

TT-O-364, Amend. 2
Oil; Linseed, Boiled (For Use in Organic Coatings)

TT-O-367
Oil; Linseed, Heat-Polymerized (Bodied), for Paint, Varnish, and Enamel

TT-O-369, Amend. 2
Oil; Linseed, Raw (For Use in Organic Coatings)

TT-O-371a
Oil; Linseed-Replacement (For Use in Organic Coatings)

TT-O-388
Oil; Soybean, Refined (For Use in Organic Coatings)

TT-O-395, Amend. 1
Oil; Tung (China-Wood), Raw (For Use in Organic Coatings)

TT-P-16a
Pads; Stamp

TT-P-18
Paint; Alkyd Resin-Emulsion, Exterior, Paste, Tints and White

TT-P-20
Paint, Blue-Lead-Base; Basic Sulfate, Linseed-Oil, Ready-Mixed

TT-P-21, Amend. 1
Paint; Cement-Water, Powder, White and Tints (For Interior and Exterior Use)

TT-P-22
Paint; Cold-Water, Exterior, Powder (With Mixing Liquid)

TT-P-23a
Paint; Cold-Water, Interior, Light-Tints and White

TT-P-24
Paint; Concrete and Masonry, Exterior, Eggshell-Finish, Ready-Mixed, White and Tints

TT-P-25a, Amend. 1
Primer, Paint, Exterior (Undercoat for Wood, Ready-Mixed, White and Tints)

TT-P-26(Navy Ships), Amend. 1
Paint (Fire Retardant, Interior White and Tints)

TT-P-27, Amend. 2
Paint; Graphite, Outside, Ready-Mixed, Black

TT-P-31b, Amend. 1
Paint; Iron-Oxide; Ready-Mixed, Red and Brown

TT-P-40, Amend. 2
Paint; Oil, Exterior, Ready-Mixed, Light-Tints and White

TT-P-47a
(Paint, Oil, Interior Nonpenetrating-Flat, Ready-Mixed, Tints and White)

TT-P-51c(Navy Ships)
Paint; Oil, Interior, Flat, Wall, Tints and White

TT-P-53, Amend. 1
Paint; Outside, Ready-Mixed, Medium-Chrome-Yellow

TT-P-54
Paint, Phosphorescent, Ready-Mixed (Non-Radioactive)

TT-P-56a
Paint; Primer-Sealer, (For) Plaster and Wallboard

TT-P-57, Amend. 1
Paint; Zinc Yellow-Iron Oxide-Base, Ready-Mixed

TT-P-59, Amend. 2
Paint; Ready-Mixed, International-Orange

TT-P-61b
Paint; Ready-Mixed, Black

TT-P-71b
Paint; Ready-Mixed, Exterior, Chrome-Green

TT-P-81a, Amend. 1
Paint; Ready-Mixed, Olive-Drab

TT-P-86a
Paint; Red-Lead-Base, Ready-Mixed

TT-P-88a
Paint; Resin-Base Emulsion, Interior, Paste, White and Tints

TT-P-91a
Paint, Rubber-Base, For Concrete Floors

TT-P-98, Amend. 1
Paint; Stencil, Flat

TT-P-102, Amend. 1
Paint (Titanium-Lead-Zinc and Oil, Exterior, Ready-Mixed, White and Light Tints)

TT-P-104, Notice 1
Paint (White Lead and Oil, Exterior, Ready-Mixed, White and Light Tints)

TT-P-115, Amend. 1
Paint; Traffic, Exterior, White and Yellow

TT-P-141b, Amend. 1
Paint, Varnish, Lacquer, and Related Materials; Methods of Inspection, Sampling, and Testing

TT-P-143, Amend. 1
Paint, Varnish, Lacquer, and Related Materials; General Specification for Packaging, Packing, and Marking

TT-P-181, Amend. 1
Paste; Masking (For Use in Painting)

TT-P-381, Amend. 2
Pigments-in-Oil; Paint-Colors

TT-P-636
Primer, Paint; Synthetic (For Ferrous Metal and Wood Surfaces)

TT-P-641, Amend. 2
Primer, Paint; Zinc Dust-Zinc Oxide (For Galvanized (Zinc-Coated or Zinc Surfaces)

TT-P-659
Primer-Surfacer; Synthetic, Tints and White (For Metal and Wood Hospital Furniture)

TT-P-691, Amend. 3.
Prussian-Blue; Dry, Paste-in-Japan, Paste-in-Oil

TT-P-781a, Amend. 1
Putty and Elastic Compound; (For) Metal Sash Glazing

TT-P-791a, Amend. 1
Putty; Pure-Linseed-Oil (For) Wood-Sash-Glazing

TT-R-58, Amend. 1
Radioactive-Luminous-Compound and Adhesives

TT-R-191a, Amend. 2
Red-Lead; Dry and Paste-in-Oil

TT-R-251a, Amend. 3
Remover; Paint and Varnish (Organic-Solvent Type)

TT-R-266
Resin, Alkyd; Solutions

TT-R-271
Resin, Phenol-Formaldehyde, Para-Phenyl

TT-S-171
Sealer, Floor; Lacquer-Type (For Oiled Wood Floors)

TT-S-176a, Amend. 2
Sealer, Floor; Varnish-Type (For Wood and Cork)

TT-S-271a, Amend. 1
Shellac (Orange) and Other Lacs

TT-S-346, Amend. 1
Sienna, Burnt and Raw; Dry (Paint-Pigments)

TT-S-706
Stain Opaque, Wood, Exterior, Oil

TT-S-711
Stain; Wood, Interior, Non-Bleeding

TT-T-266, Amend. 4
Thinner; Lacquer

TT-T-291a
Thinner; Paint, Volatile Mineral Spirits Petroleum-Spirits)

TT-T-306, Amend. 2
Thinner; Synthetic-Enamel

TT-T-425a
Titanium-Dioxide; Dry (Paint-Pigment)

TT-T-548a
Toluene (For Use in Organic Coatings)

TT-T-562, Amend. 2
Toluidine-Red-Toner; Dry (Paint Pigment)

TT-T-00656a (Ships)
Tricresyl Phosphate, Technical

TT-T-662
Triphenyl Phosphate (For Use in Organic Coatings)

TT-T-801, Amend. 1
Turpentine; Gum Spirits and Wood (Steam-Distilled and Sulfate) (For Use in Organic Coatings)

TT-T-806, Amend. 1
Turpentine; Wood (Destructively Distilled) (For Use in Organic Coatings)

TT-U-450, Amend. 1
Ultramarine Blue; Dry (Paint-Pigment)

TT-U-481
Umber, Burnt and Raw; Dry (Paint-Pigments)

TT-V-51a
Varnish; Asphalt

TT-V-61
Varnish; Damar

TT-V-71d
Varnish, Interior, Floor and Trim

TT-V-81b
Varnish: Mixing for Aluminum Paint

TT-V-86, Amend. 1
Varnish; Rubbing, Cabinet

TT-V-91b, Amend. 1
Varnish, Shellac

TT-V-109
Varnish, Spar, Alkyd-Resin

TT-V-119
Varnish, Spar, Phenolic-Resin

TT-V-121c, Amend. 1
Varnish, Spar, Water-Resisting

TT-V-130, Amend. 1
Varnish; Spirit (Shellace Varnish Replacement)

TT-V-226
Venetian-Red; Dry (Paint-Pigment)

TT-W-251b, Amend. 2
White-Lead; Basic-Carbonate, Dry, Paste-in-Oil, and Semipaste Containing Volatile Thinner

TT-W-261a, Amend. 2
White-Lead; Basic-Sulphate, Dry and Paste-In-Oil

TT-W-549
Wood-Preservative; Chemonite (Ammoniacal Copper Arsenite)

TT-W-570
Wood-Preservative; Pentachlorophenol

TT-W-571c
Wood Preservative; Recommended Treating Practice

TT-W-00572a (ArmyCE)
Wood Preservative

TT-X-916
Xylene (For Use in Organic Coatings)

TT-Y-216, Amend. 2
Yellow-Iron-Oxide; Hydrated, Synthetic, Dry Paint Pigment)

TT-Z-291, Amend. 1
Zinc-Dust (Metallic-Zinc-Powder); Dry (Paint Pigment)

TT-Z-301, Amend. 2
Zinc-Oxide; Dry and Paste-in-Oil)

TT-Z-321a
Zinc Oxide, Leaded (Dry and Paste-In-Oil)

TT-Z-415
Zinc-Yellow (Zinc Chromate); Dry (Paint Pigment)

VV-B-231a
Benzol (Benzene); Industrial-Grade

VV-K-211b
Kerosine

VV-W-95
Wax, Paraffin, Technical

ZZ-C-191a, Amend. 2
Cement; Rubber (Artists' and Photographers' and Cold-Patching)

JJJ-O-336
Oil; Linseed, Raw

JJJ-T-121, Amend. 1
Tar; Pine, Technical-Grade

JJJ-W-141, Amend. 1
Wax; Carnauba

LLL-O-358, Amend. 1
Oil; Pine

LLL-R-626, Amend. 1
Rosin

## MILITARY (JAN AND MIL) SPECIFICATIONS

MIL-D-51A
Dubbing, Protective

JAN-P-72
Primer, Synthetic, Lacquer-Resisting

JAN-L-73
Lacquer Enamel, Lustreless

JAN-E-74
Enamel, Lustreless, Quick-Drying

JAN-G-96
Gum Tragacanth (For Use in Ammunition)

JAN-C-99, Amend. 1
Cement, Pettman

MIL-A-101A
Adhesive, Water-Resistant, For Sealing Fiberboard Boxes

JAN-P-102
Packaging and Packing for Overseas Shipment, Composition Topcoating Materials, Bituminous

JAN-P-110, Amend. 1
Packaging and Packing for Overseas Shipment Drums; Metal, 55-Gallon (For Other Than Petroleum Products)

JAN-P-115, Amend. 2
Packaging and Packing for Overseas Shipment, Compound, Sealing, Dipcoating

MIL-P-116B
Preservation, Methods of

JAN-B-121
Barrier-Materials, Greaseproof

JAN-P-125, Amend. 1
Packaging and Packing for Overseas Shipment Barrier-Materials, Waterproof, Flexible

JAN-A-136, Amend. 1
Adhesive, Palletized Unit Load

MIL-A-140A
Adhesive, Water-Resistant, Waterproof Barrier-Material

JAN-C-149, Amend. 1
Compound, Protective, Strippable (Hot-Dipping)

JAN-T-152, Amend. 1
Treatment, Moisture- and Fungus-Resistant, of Communications, Electronic, and Associated Electrical Equipment: General Process For

JAN-C-168
Compound, Calking (For Wooden Vessels)

JAN-T-171, Amend. 2
Toluene

MIL-V-173A, Amend. 1
Varnish, Moisture- and Fungus-Resistant, For the Treatment of Communications, Electronic, and Associated Electrical Equipment

JAN-W-181
Wax (Candelilla)

MIL-R-249(QMC)
Repellent, Insect, M2020 and M2043

JAN-A-265, Amend. 1
Alcohol, Polyvinyl, Granular

JAN-G-276
Gum, Ester

JAN-L-296
Lacquer, Purple

JAN-G-338
Glue, Animal

JAN-A-356
Asphaltum (Gilsonite)

JAN-A-374A
Adhesive, Paste, For Demolition Charges

JAN-G-388
Compound, Sealing, N.R.C.

MIL-A-397B
Adhesive, Room-Temperature and Intermediate-Temperature Setting Resin (Phenol, Resorcinol, and Melamine Base)

MIL-G-413A, Amend. 2
Glue, Marine, and Aviation Marine (Waterproof)

JAN-P-429
Paraffin, Chlorinated

JAN-D-430
Dyes, Impregnating (For Use in Water Suspension and Solvent Dispersion Dyes)

JAN-D-431
Dyes, Impregnating, Water-Suspension (For M-2 Aqueous Process)

JAN-D-433
Dyes, Dispersion (For M-1 Solvent Process)

JAN-P-450, Amend. 2
Paint, Acid-Proof, Black (For Ammunition)

JAN-A-463, Amend. 2
Alcohol, Ethyl (For Ordnance Use)

JAN-E-480
Enamel, Baking, Phenol- or Urea-Formaldehyde

JAN-A-489
Acetone (for Ordnance Use)

JAN-C-490
Cleaning and Preparation of Ferrous Metal Surfaces for Organic Protective Coatings

MIL-[illegible]-495A
[illegible]nish, Chemical, Black, For Copper Alloys

JAN-[illegible]-511
[illegible]yes, Green and Scarlet (For Use in Ammuni[illegible]on)

JAN-[illegible]-561
[illegible]iacetin, High-Purity (Glyceryl Triacetate)

JAN-[illegible]-567
[illegible]gment, Synthetic, Black (Ointment Type)

JAN-[illegible]-589
[illegible]apalm Thickener

JAN-[illegible]-590
[illegible]llulose-Acetate-Butyrate (For Use in Pro[illegible]ctive Ointment)

JAN-[illegible]-629
[illegible]rimer, Oil-Type, For Wood (For Use With [illegible]mouflage Paint)

JAN-[illegible]-630
[illegible]int, Oil-Type, Ready-Mixed (For Camou[illegible]aging)

MIL-[illegible]-631A
[illegible]nsulation, Electrical, Synthetic-Resin Com[illegible]position, Nonrigid

JAN-M-661
Marking-Remover (Organic-Solvent-Type)

JAN-A-669
Anti-Seize Compound, White Lead Base, General Purpose (For Threaded Fittings)

JAN-P-697, Amend. 1
Paint, Inside, Light-Gray, Fire-Retardant

JAN-P-698, Amend. 1
Paint, Deck, Black

JAN-P-699, Amend. 2
Paint, Deck, Gray, Outside

JAN-P-700, Amend. 1
Paint, Deck, Gray, Inside

JAN-P-701, Amend. 1
Paint, Inside, Light-Green, Semi-Gloss, Fire-Retardant

JAN-P-702, Amend. 1
Paint, Inside, White, Semi-Gloss, Fire-Retardant

JAN-T-704B, Amend. 1
Treatment and Painting of Material

JAN-S-732, Amend. 1
Shellac Solutions (For Use in Ammunition)

JAN-P-735, Amend. 1
Primer, Paint, Zinc-Chromate, Alkyd Type

JAN-C-755
Coating, Fire-Resistant (For Woven Cotton Matting)

MIL-C-765A, Amend. 1
Camouflage Cloth, Impregnated, Flame-Resistant

MIL-D-807
Dye, Red Tracer

MIL-C-897A, Amend. 1
Cement, Rubber (Synthetic-Rubber-to-Synthetic-Rubber-Adhesion)

MIL-P-00906C(Ships)
Preservative, Wood, Oil Borne; For Ship & Boat Use

MIL-A-927A
Adhesive: Synthetic Resin (For Phenolic Laminates)

MIL-A-928(Aer)
Adhesive; Synthetic Resin (For Clad Aluminum Alloy to Wood)

MIL-C-972(Ships), Amend. 1
Compound, Rust-Preventive, Thin-Film (Polar Type)

MIL-S-974A
Surfacer; Sanding

JAN-S-1010
Sealer, Liquid, Embalming

JAN-C-1054
Compound, Germicidal Rinse

MIL-N-1056A, Amend. 1
Neats'-Foot Oil, Sulphonated

MIL-C-1068A
Compound, Water-Repellent, Textile Finish

JAN-P-1113, Amend. 1
Paint, Deck, White (Formula No. 20U)

JAN-P-1114, Amend. 1
Paint, Outside, Untinted-Base (Formula No. 5U)

MIL-E-1115A
Enamel, White (Formula 30) (For Naval Shipboard Use)

JAN-L-1118A
Lacquer, Clear, Brushing; and Thinner

JAN-W-1135
Wax (Saddler's and Stitching)

MIL-V-1137A, Amend. 1
Varnish, Electrical-Insulating (For Electro-Motive Equipment)

MIL-L-1147A
Litharge, Dry

MIL-A-1154A
Adhesive; For Attachment of Synthetic Rubber to Metal

MIL-V-1174A
Varnish, Spar, Water Resisting (Formula No. 80)

MIL-P-1226A
Paint, Antifouling (For Low-Speed, Wood-Bottom Boats) (Formula No. 16X)

MIL-P-1232A
Paing, Deck, Red (Formula No. 23)

MIL-P-1264A
Paint, Outside, White (Formula No. 6)

MIL-T-1355
Thinner, Enamel, Quick-Evaporating (For Use in Precoating Reconditioned Subsistence Cans)

MIL-F-1489
Finish, Ski, Repair

MIL-W-1510
Wax, Ski

MIL-S-1737(Ships)
Spray, Liquid, Deodorant

MIL-C-1828
Compound, Spray, for Upper Leather

MIL-C-1829
Compound, Oil, Sole Treating

MIL-P-2018
Paint, Face, Camouflage, Stick Form (Army)

MIL-E-2051
Enamel, Synthetic, Lustreless, Textured, Olive Drab (For Refinishing Helmets, Steel M-1 and M-3 in the Reclamation Program)

MIL-E-2052
Enamel, Textured, Olive Drab (For Coating of Liners, Helmet)

MIL-I-2175
Insecticide-Ingredient; Solvent for DDT

MIL-I-2179
Insecticide-Ingredients; Aliphatic Thiocyanates, Straght-Chain

MIL-W-2238
Wax, Bone, Sterile

MIL-I-2260, Amend. 1
Insecticide Aerosol (Dichlorodifluoro-methane Solvent), in Dispensers or Charging Cylinders

MIL-C-2399
Cement, Liquid, Butyl, Tent Patching

MIL-L-2638
Lacquer, Vinyl Resin, Gasoline-and Water-Resistant

MIL-C-2749
Cement, Synthetic (For Hard Cellular Buoyancy-Material)

MIL-C-2751
Compound, Soot-Remover

MIL-M-2776
Monoethanolamine (Ethanolamine)

MIL-P-2782
Pots, Paint

MIL-P-2852
Paint, Striping, Blue (Formula No. 43)

MIL-P-2853
Paint, Striping, Yellow (Formual No. 42)

MIL-P-2854
Paint, Striping, Green (Formula No. 39)

MIL-P-2856
Paint, Striping, Black (Formula No. 38)

MIL-C-2869
Compound, Synthetic (For Hose-Cover Repair)

MIL-D-2905
Deck-Covering, Light-Weight, Nonslip (Abrasive-Coated Fabric and Cement)

MIL-C-2908
Cement, Insulation, Asbestos, Finishing

MIL-P-2909
Pumice, Ground (Abrasive Pigment)

MIL-C-2910
Covering, Organic-Plastic (For Instrument Bodies)

MIL-P-2934
Paint, Striping, Red (Formula No. 40)

MIL-A-3029, Amend. 1
Asphalt, Waterproofing (For Use in Manufacture of Fiber Ammunition Containers)

MIL-R-3043, Amend. 1
Resin-Coating, Permanent (For Internal Engine Parts)

MIL-S-3050A
Sprayer, Paint, Pneumatic (For Bituminous Emulsion)

MIL-I-3064
Insulation, Electrical, Plastic-Sealer

MIL-A-3070
Agitator, Paint, Pneumatic (For Attachment to 55-Gallon Drum)

MIL-S-3105
Sealing Compound, Inert (For Use in Ammunition)

MIL-C-3116
Cement; Acrylic-Monomer-Base (For Acrylic Plastic)

MIL-A-3167, Amend. 1
Adhesives (For Plastic Inhibitors)

MIL-W-3172
Wax, Laboratory (Chattertons Compounds)

MIL-C-3254, Amend. 2
Coating-System, Bridging, Strippable, Sprayable

MIL-C-3301, Amend. 1
Compound, Asphaltic, Hot-Melt (Cavity Lining)

MIL-P-3320A
Painting: Freight Cars

MIL-P-3321A, Amend. 1
Painting: Locomotives and Railway Work Equipment

MIL-P-3324
Paraffin, Wax, (Refined, for Histological, Pharmaceutical and Dental Use)

MIL-R-3472
Roof-Coating; Asphalt-Base Emulsion

MIL-T-3530A
Treatment, Mildew-Resistant, for Thread and Twine

MIL-P-3542
Primer: Pressure-Sensitive Tape

MIL-S-3562
Sealing Materials (For Filters)

MIL-S-3569
Sealer, Joint, Sewer, Bituminous Mineral-Filled, Hot-Pour

MIL-F-3622
Flame Resistant Compound, Fabrics (Colorless, Emulsifiable)

MIL-R-3745
Resin, Phenol-Formaldehyde, Laminating

MIL-P-3846
Painting: Steel-Hull Vessels (Transportation Corps)

MIL-C-4003(USAF)
Cement; General Purpose, Synthetic Base

MIL-S-4363(USAF)
Sealant Topcoat, Fuel Tank, Buna-N Type

MIL-R-5001, Amend. 1
Rubber; Latex Foam Sponge

MIL-S-5002, Amend. 1
Surface Treatments (Except Priming and Painting for Metal and Metal Parts in Aircraft)

MIL-D-5043A(Aer)
Sealing Compound; Synthetic Rubber, Catalyzed (For Integral Fuel Tanks)

MIL-C-5044, Amend. 1
Coating; Aircraft Walkway, Nonslip, Brush and Spray

MIL-C-5050
Coating; Aircraft Walkway, Application of

MIL-P-5051, Amend. 1
Paint; Anti-Fouling (For Aircraft Hull Bottoms)

MIL-P-5052
Paint; Antifouling, Application to Aircraft Hull Bottom

MIL-P-5054, Amend. 1
Paint; Elastomeric, Low Gloss, Camouflage, For Aircraft Tires and De-icer Boots)

MIL-F-5055, Amend. 1
Finishes; Aircraft, Application and Treatment of, for Producing Aerodynamically Smooth Surfaces

MIL-C-5056
Coating, Permanent; Process for Application of, to Aircraft Parts

MIL-A-5090(Aer)
Adhesives; Synthetic Resin (For Clad Aluminum Alloy)

MIL-C-5092(Aer), Amend. 1
Cement, Rubber (Synthetic and Reclaimed Rubber Base)

MIL-C-5410A, Amend. 2
Compound; Cleaner and Brightener, Nonflammable (For Use on Aluminum Surfaces)

MIL-C-5429A
Coating; Strippable, Protective, Aircraft Bearing

MIL-A-5433A, Amend. 1
Adhesive Application of Room-Temperature and Intermediate-Temperature-Setting Resin (Phenol, Resorcinol, and Melamine Base)

MIL-A-5534A
Adhesive High-Temperature-Setting Resin (Phenol, Melamine and Resorcinol Base)

MIL-A-5535A
Adhesive; Application of High-Temperature-Setting Resin (Phenol, Melamine, and Resorcinol Base)

MIL-C-5537
Cellulose Acetate Butyrate

MIL-C-5538
Cellulose-Nitrate

MIL-C-5539
Cement; Natural Rubber

MIL-C-5540
Cement; Neoprene

MIL-C-5541
Chemical Films for Aluminum and Aluminum Alloys

MIL-C-5542
Compound; Anti-Seize and Sealing (For Oxygen Systems)

MIL-C-5544
Compound; Anti-Seize, Graphite-Petrolatum

MIL-C-5545A, Amend. 1
Compound, Corrosion Preventive, Aircraft Engine, Heavy Oil Type

MIL-D-5549A, Amend. 1
Dope; Cellulose-Acetate-Butyrate, Clear for Aircraft Use

MIL-D-5550A, Amend. 1
Dope; Cellulose-Acetate-Butyrate, Pigmented, Camouflage

MIL-D-5551A, Amend. 2
Dope; Cellulose-Acetate-Butyrate, Pigmented, Gloss

MIL-D-5552A
Dope, Cellulose, Nitrate, Colorless, Gloss, For Aluminum Dope

MIL-D-5553A
Dope; Cellulose Nitrate, Clear

MIL-D-5554A
Dope, Cellulose Nitrate, Gloss

MIL-D-5555, Amend. 1
Dope; Cellulose Nitrate, Pigmented, Camouflage

MIL-E-5556, Amend. 1
Enamel; Camouflage, Quick Drying

MIL-E-5557, Amend. 1
Enamel; Heat-Resisting, Glyceryl-Phthalate, Black

MIL-E-5558A
Enamel; Wrinkle-Finish, For Aircraft Use

MIL-F-5562A
Fluid; Bubble Sextant

MIL-F-5566
Fluid; Anti-Icing (Isopropyl Alcohol)

MIL-S-5817A
Sealant; Fuel Tank, Polysulfide Polymer, Solvent-Type

MIL-B-6030(Aer)
Barrier Material ; Sprayable, Strippable, Protective, For Aircraft Surfaces (Aluminized Type)

MIL-L-6047, Amend. 1
Lacquer; Aromatic Fuel-Resistant

MIL-O-6083A, Amend. 2
Oil; Preservative, Hydraulic Equipment

MIL-A-6091
Alcohol; Ethyl, Specially Denatured, Aircraft

MIL-V-6093
Varnish; Decalcomania Adhesive

MIL-T-6095A
Thinner, Cellulose-Nitrate-Dope, Blush-Retarding

MIL-T-6096
Thinner; Cellulose Acetate Butyrate Dope

MIL-T-6097
Thinner; Cellulose Acetate Butyrate Dope, Blush Retarding

MIL-T-6121, Amend. 1
Tinting Paste; Zinc Chromate Primer

MIL-C-6708
Compound; Exterior-Surface, Hard-Film Corrosion-Preventive

MIL-C-6796
Coatings; Protective (For Wood)

MIL-C-6798
Coating; Rust Inhibiting (For Metal Containers)

MIL-C-6799A
Coating; Protective (For Acrylic Plastic Sheet)

MIL-C-6800A, A mend. 1
Coating; Process for Application of Permanent Resin to Aircraft Engine Parts

MIL-C-6801
Cresol

MIL-E-6802
Enamel; Porcelain

MIL-L-6805A, Amend. 2
Lacquer, Camouflage

MIL-L-6806
Lacquer; Clear, Aluminum Clad Aluminum Alloy Surfaces

MIL-P-6808
Primer, Zinc Chromate; Application of

MIL-P-6883
Paint, Blended-Type, Coal-Tar-Pitch Base, Butuminous

MIL-P-6884, Amend. 1
Paint, Temporary Identification

MIL-P-6889A, Amend. 4
Primer; Zinc-Chromate, For Aircraft Use

MIL-P-6890A
Primer; Zinc-Chromate, Reclamed Blended

MIL-S-6892
Stripper, Cleaner and Paint, For Ferrous Surfaces

MIL-V-6894A
Varnish, Oil Type, Gloss Finish, Glyceryl Phthalate Base

MIL-V-6895, Amend. 1
Varnish, Wood Propeller

MIL-S-7124
Sealing-Compound, Pressure-Cabin

MIL-S-7126A
Sealing Compounds Synthetic Glass

MIL-L-7146(Aer)
Lacquer; Hydraulic Fluid Resistant (For Interior Aircraft Use)

MIL-S-7178, Amend. 2
Lacquer; Cellulose Nitrate, Gloss, For Aircraft Use

MIL-F-7179, Amend. 1
Finishes and Coatings; General Specification For Protection of Aircraft and Aircraft Parts

MIL-S-7502(USAF), Amend. 2
Sealing Compound; Synthetic Rubber, Catalyzed for Integral Fuel Tanks

MIL-C-7504(USAF)
Cement, Sealing, General Purpose, Plastic

MIL-E-7729, Amend. 2
Enamel; Gloss, For Aircraft Use

MIL-R-7751A
Remover, Paint and Varnish (Silicate Type)

MIL-D-7850
Dope; Cellulose-Acetate-Butyrate, First Coat, Fungicidal

MIL-E-7851
Enamel; Wrinkele-Finish, For Aircraft Use, Application of

MIL-C-7853, Amend. 2
Compound; Corrosion-Preventive, Aircraft Engine

MIL-P-7962(Aer)
Primer, Lacquer Type; Corrosion-Inhibiting, Fast Drying (For Spray Application Over Pretreatment Coating)

MIL-L-8067(USAF)
Leather Dressing; Fungus-Preventive

MIL-P-8116(USAF)
Putty, Zinc Chromate, General Purpose

MIL-S-8141(USAF)
Strippable Plastic Coating, Sprayable

MIL-C-8576
Cement, Acrylic Monomer Base, For Acrylic Plastic

MIL-S-8516(Aer)
Sealing Compound, Synthetic Rubber, Catalyzed (For Electric Connectors and Electric Systems)

MIL-C-8618(Aer)
Coating System; Rain Erosion Resistant, For Plastic Laminates

MIL-R-10036A
Rust Arresting Compound (For Treatment of Rusted Metal)

MIL-L-10095A
Leather Dressing, Preservative and Mildew Preventive

MIL-S-10103(QMC)
Surfacer, Lacquer (Lacquer Resistant)

MIL-S-10104A
Sheets; Metal, Coated (Clear or Pigmented Coating)

MIL-E-10164(QMC)
Enamel; Gloss, Synthetic, (For Closure of Water Can)

MIL-E-10169(QMC)
Enamel, Heat-Resisting

MIL-S-10181(ORD)
Surfacer; Sanding, Lacquer Type

MIL-L-10182(ORD)
Lacquer; Cellulose Nitrate, Automotive

MIL-C-10183(ORD)
Compound, Rubbing (For Lacquered Surfaces)

MIL-E-10242(QMC)
Enamel, Stencil, Gloss

MIL-L-10287A
Lacquer, Cellulose Nitrate for Identification of Small Arms Ammunition

MIL-H-10330A
Hansa Yellow G

MIL-L-10331(Ord)
Leather, Moisture- and Mold-Resistant Treatment

MIL-P-10380(CE), Amend. 1
Packaging of Paint, Varnish, Lacquer, and Related Materials (For Overseas Shipment)

MIL-W-10427A, Amend. 1
Water-Repellent Compound; Filter Material Finish

MIL-A-10428(CmlC)
Alcohol, Isopropyl

MIL-B-10481(Ord), Amend. 1
Bituminous Coating (For Sealing)

MIL-C-10506A, Amend. 1
Coatings, Exterior, For Tinned Food Cans

MIL-T-10513A(SigC)
Tropicalization of Materials Used in Signal Corps Equipment

MIL-S-10561(Ord)
Solvent, Cleaning, High Temperature Pressure Spray

MIL-C-10578(Ord), Amend. 1
Compound, Metal Conditioner and Rust Remover (Phosphoric Acid Type)

MIL-M-10598A
Mildew Preventive Tablet, Volatile

MIL-S-10617(QMC)
Stain; Wood, Non-Grain-Raising, Solvent-Dye Type

MIL-C-10659(CmlC)
Chloroform (Technical)

MIL-E-10663A
Ether, 2,2'-Dichloroethyl (Technical Grade)

MIL-C-10668(QMC)
Cement, Liquid and Cemented Tape, For Tent Construction

MIL-E-10687A
Enamel; Lustreless, Quick-drying (For Ammunition)

MIL-E-10692(Ord)
Di-(2 Ethyl-Hexyl) Sebacate

MIL-W-10842(CmlC)
Wax, Microcrystalline

MIL-M-10851A
Methyl Methacrylate Polymer

MIL-E-10853A
Ethyl Cellulose, for Munitions

MIL-C-10979(CmlC)
Coating, Exterior, Air-Drying, With Primer (For One-Ton Containers and Steel Drums)

MIL-S-11030A(Ord)
Sealing Compound; Non-Curing (Polysulfide Base)

MIL-S-11031A(Ord)
Sealing Compound, Adhesive; Curing (Polysulfide Base)

MIL-C-11080(CmlC)
Coating, Corrosion-Resistant (For Aluminum Gas Mask Canisters)

MIL-S-11090(Ord), Amend. 2
Solvent, Degreasing, Self-Emulsifying

MIL-S-11123(QMC)
Sealer, Sanding, Lacquer Type (For Wood Furniture)

MIL-L-11195A
Lacquer, Lustreless, Hot Spray

MIL-E-11237(Ord)
Enamel, Synthetic, Lustreless

MIL-P-11297(CE)
Paint, Fire-Retardant, For Interior Fiberboard Surfaces

MIL-F-11375(QMC)
Filler, Wood

MIL-L-11376(QMC), Amend. 1
Lacquer, Rubbing, Clear (For Wood Furniture)

MIL-P-11414A
Primer; Lacqer, Rust-Inhibiting

MIL-C-11532(CmlC)
Casein

MIL-C-11728A
Compound, Corrosion-Inhibiting and Lubricating, For Gas Cylinder Cap Threads

MIL-C-11796A
Corrosion Preventive, Petrolatum, Hot Application

MIL-E-11857(Ord)
Enamel, Synthetic, Semi-Gloss

MIL-T-12014(CmlC)
Tributylamine, Normal

MIL-P-12050(CmlC)
Perchloroethylene, Technical

MIL-W-12062(CmlC)
Wax, Petroleum (For waterproofing munitions)

MIL-F-12070(CmlC)
Fog Oil

MIL-T-12093(CmlC)
Thinning Oil (For Marine Glue)

MIL-R-12123(QMC)
Repellent, Insect, Clothing Treatment, Formula M-1960

MIL-C-12140(QMC)
Cream, Protective, Flashburn

MIL-T-12879(QMC)
Treatments, Chemical, Prepaint and Corrosion Inhibitive, For Zinc Surfaces

MIL-R-15075(Ships)
Fingerprint Remover

MIL-P-15076A, Amend. 1
Protective Coating Material, (Polymer-Powder) (Product of an Organic Dihalide and an Inorganic Polysulfide)

MIL-E-15090B, Amend. 1
Enamel, Equipment, Light-Gray (Formula No. 111)

MIL-P-15123A
Paint, Boot-Topping, Black (For Wooden Vessels) (Formula No. 3)

MIL-P-15124A
Paint, Tinting, Black (Formula No. 101)

MIL-P-15125A
Paint (Anti-Fouling For High-Speed, Wood Bottom Boats)

MIL-P-15128A
Paint, Outside, Navy-Blue (Formula No. 5NB) (For Naval Shipboard Use)

MIL-P-15129A
Paint, Outside, Navy-Gray, No. 7

MIL-P-15130A
Paint, Outside, Haze-Gray, No. 27 (Formula No. 5H) (For Naval Shipboard Use)

MIL-P-15142(Ships), Amend. 1
Putty, Spotting, White

MIL-P-15143(Ships)
Protective-Coating (Heat-Hardening), Phenol-Formaldehyde

MIL-P-15144A
Paint, Fire-Retardant (Binder for Anti-Sweat Coatings) (Formula No. 34)

MIL-P-15145(Ships)
Paint, Zinc-Dust (For Fresh Water Tanks) (Formula No. 102)

MIL-P-15146A
Paint, (Outside, Dull Black Formula No. 104)

MIL-F-15147A
Primer and Enamel, Coal Tar

MIL-P-15149(Ships)
Paint, Stencil

MIL-P-15150A
Paint, After-Pickling, Red (Formula No. 84/47R)

MIL-P-15151A
Paint (After-Pickling, Green, Formula No. 84/47G)

MIL-P-15152A
Paint, Antifouling (For Natural Rubber) (Formula No. 15-NRL)

MIL-C-15159(Ships)
Compound, Preservative; Fire-, Water-, Mildew-, and Weather-Resistant (For Canvas)

MIL-C-15166A
Copper Pigment (For Use in Antifouling Paint)

MIL-C-15167(Ships), Amend. 1.
Compound, Rust-Preventive, Thick-Film (Pigmented and Nonpigmented)

MIL-C-15169(Ships)
Cuprous-Oxide

MIL-D-15170A
Deck Covering, Lightweight, Nonslip (Abrasive-Filled Synthetic Binder)

MIL-E-15171(Ships)
Enamel, Wrinkle-Finish, Black

MIL-L-15172A
Lead-Acetate Technical (Sugar of Lead)

MIL-M-15173(Ships), Amend. 1
Magnesium-Silicate (Flatting Extender Pigment)

MIL-M-15174A
Methyl Abietate, Hydrogenated (Plasticizer)

MIL-T-15175A
Toner, Methyl Violet (Dry Powder)

MIL-M-15176A
Mica (Extender Pigment)

MIL-M-15177A
Mercuric Oxide

MIL-N-15178A
Naphtha, Solvent

MIL-C-15179A
Castor Oil (Dehydrated)

MIL-L-15180A
Linseed Oil, Alkali-Refined

MIL-P-15181(Ships)
Paint, Outside, Light-Grey, No. 37 (Formula No. 5L) (For Naval Shipboard Use)

MIL-P-15182A
Paint, Outside, Gray (Formula No. 46) (For Naval Shipboard Use)

MIL-P-15183A
Paint, Outside, Gray, No. 11 (Formula No. 109)

MIL-R-15184(Ships)
Resin, Para-Phenyl, Phenol-Formaldehyde

MIL-M-15188A
Manganese Linolate

MIL-R-15189A
Resin Phenolic (Alkyd Phenol, Oil-Soluble)

MIL-R-15190(Ships)
Resin, Phenol-Modified-Alkyd, Solution

MIL-S-15191(Ships)
Silica, Diatomaceous (Flatting-Extender Pigment)

MIL-S-15192A
Silica, Pulverized

MIL-S-15193(Ships)
Stains

MIL-T-15194A
Tar, Coal

MIL-P-15195A
Pigment (Titanium-Calcium)

MIL-V-15196A
Vermiculite, Expanded (Pigment)

MIL-A-15197A
Antimony-Sulfide (Pigment) (Paint Ingredient)

MIL-C-15198A
Calcium Carbonate, Precipitated (Pigment)

MIL-C-15200A, Amend. 1
Cement, Linoleum

MIL-C-15201A
Cement, Linoleum (Fire Retardant)

MIL-C-15202A
Cement, Smoothing (Formula No. 62)

MIL-C-15203(Ships)
Coating, Bituminous Emulsion

MIL-S-15204A
Compound, Joint and Thread, High Temperature

MIL-C-15205(Ships)
Compound, Metal-Conditioning

MIL-A-15206A
Aluminum Stearate

MIL-V-15218A
Varnish, (Mixing, Phenolic)

MIL-W-15234A
Whiting

MIL-I-15265(Ships)
Insulation, Electrical, Liquid, Air-Dry (Submarine Bus Bar Coating)

MIL-C-15275A
Coating, Plastic (For Canvas)

MIL-C-1528A
Coating, Pretreatment (Formula No. 117 for Metals)

MIL-P-15422A
Polish, Metal (Liquid)

MIL-P-15423A
Polish, Metal (Silver, Liquid)

MIL-Z-15486A, Amend. 1
Zinc-Oxide, Technical (Acicular, Paint Use)

MIL-C-15705A
Calking Compound (Liquid Polymer Polysulfide Synthetic Rubber, Formula No. 112, for Metal Enclosures)

MIL-G-15793(BuOrd), Amend. 2
Grease Instrument

MIL-C-15799(BuMed)
Cement, Sealing

MIL-P-15929A
Primer, Paint, Vinyl-Red Lead Type, Formula No. 119

MIL-P-15930A
Primer, Paint, Vinyl-Zinc Chromate Type, Formula No. 120

MIL-P-15931A
Paint, Anti-Fouling, Vinyl-Red (Formula No. 121)

MIL-P-15932A
Paint, Outside, Gloss-Black (Vinyl-Alkyd) (Formula No. 122-1)

MIL-P-15933A
Paint, Outside, Dull-Black (Vinyl-Alkyd), (Formula No. 122-3)

MIL-P-15934A
Paint, Outside, Gray, No. 7 (Vinyl-Alkyd) Formula No. 122-7)

MIL-P-15935A
Paint, Outside, Gray, No. 11 (Vinyl-Alkyd) (Formula No. 122-11)

MIL-P-15936A
Paint, Outside, Gray, No. 27 (Vinyl-Alkyd) (Formula No. 122-27)

MIL-P-16188A
Paint, Outside, Gray, No. 17 (Vinyl-Alkyd) (Formula No. 122-17)

MIL-P-16189A
Paint, Anti-Fouling, Vinyl, Black (Formula No. 129)

MIL-C-16232(BuOrd), Amend. 1
Coatings-Phosphate; Oiled, Slushed or Waxed (For Ferrous Metal Surfaces) and Phosphate Treating Compounds

MIL-C-16245A
Cements, Sealing (Double Planking, Preservative)

MIL-I-16372(S&A), Amend. 1
Ink, Lithographic, Duplicating, Offset Press

MIL-V-16399(BuOrd)
Varnish, Moistureproof

MIL-P-16406(BuOrd)
Paint, Black, High-Gloss, Quick Drying

MIL-P-16501A
Paint, Outside, Gray, No. 37 (Vinyl-Alkyd Type) (Formula No. 122-37)

MIL-P-16502A
Paint, Outside, Gray, No. 46 (Vinyl-Alkyd Type) (Formula No. 122-46)

MIL-L-16504(BuOrd)
Lacquer, Sealing (For Ammunition)

MIL-C-16555(BuOrd)
Coating Solution, Spray Type, Adhering

MIL-I-16557A
Ink, Marking, Quick-Drying (For Non-Porous Surfaces)

MIL-C-16558A
Coating, Organic (For Covering Shafts, Struts, and Other Exposed Surfaces)

MIL-E-16583(BuOrd)
Enamel, Electrically Conductive

MIL-S-16684A, Amend. 1
Surface Conditioner, Plastic

MIL-P-16709(Ships), Amend. 2
Paint, Black (Coating for 55-Gallon Drums and Other Metallic Surfaces—Exterior)

MIL-P-16738A
Paint, Outside, White, Vinyl-Alkyd (Formula No. 122-82)

MIL-C-16923A, Amend. 1
Compound, Embedding (For Electronic Equipment)

MIL-E-17133A
Enamel, Cream, Gloss (Formula No. MSTS-1)

MIL-E-17134A, Amend. 1
Enamel; Light Gray, Gloss (Formula No. MSTS-2)

MIL-E-17136A
Enamel; Beach-Sand, Semigloss (Formula No. MSTS-3)

MIL-E-17137A
Enamel; Red, Gloss (Formula No. MSTS-4)

MIL-E-17138A
Enamel, Medium Blue, Gloss (Formula No. MSTS-5)

MIL-E-17139A
Enamel, Jade Green, Gloss (Formula No. MSTS-6)

MIL-E-17140A
Enamel, Marine Green, Semigloss (Formula No. MSTS-7)

MIL-E-17152A
Enamel, Dark Oak, Gloss (Formula No. MSTS-14)

MIL-S-17175(BuOrd)
Sealing Compound, Asphalt Base, For Ammunition

MIL-I-17205A
Insulation Cloth and Tape; Electrical (Glass-Fiber, Varnished)

MIL-M-17222A
Mildew Resistant Compound; 2,2' Dihydroxy-5,5' Dichloro Diphenyl Methane

MIL-M-17231A
Mildew Resistant Compound; Copper Naphthenate

MIL-E-17325(Ships)
Enamel, Rose-Wood, Semi-Gloss (Formula No. MSTS-8)

MIL-E-17326(Ships)
Enamel, Clipper Blue, Semi-Gloss (Formula No. MSTS-9)

MIL-E-17327(Ships)
Enamel, Light Gray, Semi-Gloss (Formula No. MSTS-10)

MIL-E-17328(Ships)
Enamel, Cloud Gray, Semi-Gloss (Formula No. MSTS-11)

MIL-E-17329(Ships)
Enamel, Light Blue, Semi-Gloss (Formula No. MSTS-12)

MIL-E-17330(Ships)
Enamel, Sea Spray Blue, Semi-Gloss (Formula No. MSTS-13)

MIL-S-17377(Ships)
Sealing Compound, Boiler-Casing

MIL-E-17466(Ships)
Enamel, Sun Glow, Semi-Gloss (Formula No. MSTS-15)

MIL-P-17544(Ships)
Primer, Paint, Shipboard, Alkyd-Red Lead Type, Dark, Formula No. 116D

MIL-P-17545(Ships)
Primer, Paint, Shipboard, Alkyd-Red Lead Type, Formula No. 116

MIL-I-17563(Ships)
Impregnating Compound, Copper Alloy Casting

MIL-P-17567(MOrd)
Plaster, Acid and Alkali Resistant; Molding Material and Molded Parts

MIL-C-17711(NOrd)
Coatings, Chromate, For Zinc Alloy Castings and Hot-Dip Galvanized Surfaces

MIL-C-20071
Compound, Polishing

MIL-P-20087, Amend. 1
Paint, Heat-Resisting

MIL-P-20090
Paint, Striping, Brown (Formula No. 41)

MIL-C-20207B, Amend. 1
Cleaning Compound, Solvent Emulsion Grease Removing

MIL-L-20209
Lacquer, Strippable, Spray or Dip (For Packaging)

MIL-W-20298
Waterproofing Compound

MIL-C-20299
Compound, Adhesive, Waterproof

MIL-S-20526
Shellac, Orange Gum, White Bleached, Refined Bleached

MIL-T-20618
Treatment; Fire-, Laundry-, Dry-Cleaning-, and Mildew-Resistant (For Cotton Fabrics)

MIL-P-20628
Putty, Sealing, For Bolted-Steel Petroleum Tanks

MIL-E-20666
Enamel, Glyceryl Phthalate, Infrared Reflecting (For Coating Pipe-Line Equipment)

MIL-STD-603
Fuze Thread Luting (For Special Ammunition Use)

### DEPARTMENT OF THE AIR FORCE

3-138-A
Compound, Waterproofing

2409
Adhesives, Sealing, Grade "C" Greaseproof Barrier Materials

3603, Amend. 2
Compound, Liquid Instrument Sealing

12049
Resin, Low Pressure Laminating

14057-C
Paint, Water, Dry

14102A, Amend. 2
Luminescent Material; Phosphorescent

14115
Surfacer; Wood, Liquid

14119-C, Amend. 2
Remover; Paint, Aircraft, Finish

14129
Paint; Bullet Tipping

14137, Amend. 1
Cement, Cellulose Nitrate Base

14140, Amend. 2
Glue; Application of Low-Temperature Setting Resin (Phenol, Melamine & Resorcinol)

14141
Preservative; Non-Water-Repellent Treating Solution for Wood

14144B
Sealant; Fuel Tank, Fill and Drain Style

14149
Glue; Application of Water and Mold Resistant Casein

14152, Amend. 1
Compound; Adhesive (For Aircraft Walkways)

14154
Compound; Refinishing, Horsehide Leather

14155
Compound; Preventive, Sap Stain, Green Lumber

14157
Luminescent Material, Fluorescent

14158, Amend. 1
Coating; Protective, For Rubber Surfaces

14160, Amend. 1
Fungicide; Field Treatment, Material Protectant

14164
Adhesive, Metal to Metal, Structural

20029
Varnish; Synthetic, For Metal Containers

20032
Cementing Metal to Metal and Metal to Wood, Process For

24114A
Camouflage Finishes for Aircraft

26610
Cement; Aromatic Fuel Resistant, Synthetic Base

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### DEPARTMENT OF THE ARMY

2-119
Compound, Anti-Seize; Mica-Base (For Threaded Fittings)

3-102D, Amend. 1
Glue (For Use in the Loading of Ammunition)

3-138A
Compound; Waterproofing (For Fabrics)

3-163
Lacquer (For Landing Light Reflectors)

3-165A
Primer, Metal; Quick-Drying

3-167, Amend. 1
Varnish, Phenol Formaldehyde Resin

3-169
Glue, Vegetable

3-182, Amend. 2
Compound, Insulation, Ignition

3-184
Lacquer, Rust-Inhibiting, Clear

3-186
Sealer, Wood, Preservative

3-188
Enamel, Wrinkle, Baking

3-189A
Stain, Preservative, Water Soluble

3-190A
Stain, Preservative, Asphaltic Type

3-193A, Amend. 1
Primer, Phenolic (Water Immersible)

3-194A, Amend. 2
Enamel, Phenolic, Lustreless, Outside

3-197A
Surfacer, Synthetic

3-198, Amend. 1
Lacquer, Ethyl Cellulose, Special (For Ordnance Material)

3-199, Amend. 2
Lacquer, Lustreless Sand, Obliterating

3-200
Cement, Sealing or Plugging

3-201
Primer, Zinc Yellow

3-202
Stain, Wood, Olive Drab

3-205
Protective Coating Materials, Phenolic Resin Base, Air-drying (For the Interior of Steel Potable-Water Tanks)

3-206
Paint, Traffic, Runway, Black

3-214
Compound, Waterproofing for Small Arms Ammunition

3-215, Amend. 1
Compound, Tung (Chinawood) Oil Base

3-216
Finish, Protective, Gun Stock (For Small Arms)

3-221, Amend. 1
Varnish, Phenolic, Baking

4-116, Amend. 2
Wood Preservative Concentrate: Pentachlorophenol

4-1131A
Compound, Textile Preservative, For Field Treatment

20-29C, Amend. 1
Cement, Rubber

39-36
Paint, Camouflage, Bituminous-Emulsion

43-17
Painting: Hospital & Kitchen Cars

50-11-106
Varnish, Special (For Use in Ammunition)

51-0-4
Painting and Finishing of Artillery Material Other Than Fire Control; General Specification For

51-70-1A
Painting and Finishing of Fire Control Instruments; General Specification For

57-0-2C, Amend. 2
Finishes, Protective, for Iron and Steel Parts

62-1
Compound, Potting

62-2, Amend. 1
Compound: Insulating and Sealing, Electrical Connections

62-4, Amend. 1
Adhesive, Synthetic Rubber (Hot or Cold Bonding)

62-6 Amend. 1
Adhesive for Cellulose Nitrate Film on Metals

65-45
Painting: Wood Hull Vessels

65-46
Painting: Steel-Hull Vessels

71-447
Beeswax Compound, Type IC-2

71-448-A
Stearine Compound, Type IC-3

71-449-A
Insulating Compound IC-1

72-53, Amend. 1
Finishes (For Ground Signal Equipment)

100-12A, Amend. 1
Infrared Reflectance of Camouflage and Other Materials; Method of Test For

### CHEMICAL CORPS TENTATIVE SPECIFICATIONS

196-131-59A
Lacquer, Air-Drying and Thinner (High Hiding Power)

197-54-144B
Lacquer, Air-Drying and Thinner (For Crimped Parts)

197-54-381
Cement, Neoprene

197-54-394A
Mildewproofing; General Specification

197-54-455
Coating, Protective (Acetylene Tetrachloride Resistant)

### CORPS OF ENGINEERS TENTATIVE SPECIFICATIONS

T-1279 D
Paint, Camouflage, Oleoresinous, Emulsifiable

T-1290 A, Amend. 1
Reflectorized Coating Systems (Retro-directive)

T-2278
Mildew-Proofing of Cork Products

### CORPS OF ENGINEERS — CIVIL WORKS CONSTRUCTION

CE-1409 (Civil Works Guide Specification), Revised
Painting Hydraulic Structures and Appurtenant Works
Manual of Recommended Painting Practice for Corps of Engineers Construction, No. 1 (INT), 12 March 1947

### FRANKFORD ARSENAL TENTATIVE SPECIFICATIONS

FXS-284, Rev. 5
Lacquer; Opaque or Transparent, Identification of Small Arms Ammunition

FXS-339
Paint, Lead-Free, Green, For Artillery Projectiles

FXS-894
Paint, Lustreless, For Ammunition Packing Boxes

FXS-934, Amend. 1
Enamel: Lacquer, Nitrocellulose, Gloss, (For Electrical Terminations)

FXS-944
Cement, Synthetic Rubber (Oil Resistant)

### ORDNANCE DEPARTMENT TENTATIVE SPECIFICATIONS

AXS-673, Rev. 2
Compound Rust Preventive, Thin Film

AXS-816
Lacquer, Olive Drab, Lustreless (For Plastic Compositions)

AXS-829, Amend. 1
Paint, For Metal Parts of Ammunition Containers (Roller-Coat Application)

AXS-875, Amend. 2
Methanol

AXS-962
Paint, Lustreless, Gasoline-Removable

AXS-964
Marking Material (For Stained Wooden Crates & Boxes)

AXS-1167
Compound, Protective, Ethylcellulose, Stripping

AXS-1258
Lacquer Primer, Rust-Inhibiting, (For Ammunition)

AXS-1287, Amend. 1
Primer, Synthetic, Yellow-Green

AXS-1416
Compound, Moisture and Moldproofing (For Leather)

AXS-1449
Enamel, Porcelain

AXS-1472
Adhesive, Label (Water-Resistant)

AXS-1479, Rev. 1
Xylene

AXS-1498
Adhesives, Rubber: General Specifications, Test Methods

AXS-1520
Cement, Vinyl Acetate Base

AXS-1678
Enamel, Non-Skid, Lustreless

AXS-1680
Varnish, Phenol-Formaldehyde, and Aluminum, Air Drying

AXS-1734, Amend. 1
Ready To Mix Aluminum Paint and Alkyd Type Vehicle

### ROCK ISLAND ARSENAL TENTATIVE SPECIFICATIONS

RIXS-113
Lacquer for Leather and Webbing

RIXS-122, Rev. 2
Paint, Luminous, Non-Radioactive

RIXS-138
Cement, Rubber for Cartridge Storage Case Gaskets

### SIGNAL CORPS TENTATIVE SPECIFICATION

72-95, Amend. 1
Coating Materials, Hot-Melt (Moisture- and Fungus-Resistant)

### DEPARTMENT OF THE NAVY

17-I-16c
Insulating-Material, Electrical, Liquid, Quick-Drying

17 L 18
Luminous-Material and Equipment (Non-Radioactive), Electric-Lamp-Activated

52 C 41
Coating, Strippable, Spray-Type

52 E 3
Enamel, Porcelain (For Coating)

52 P 75
Paint, Camouflage, Resin-Oil-Emulsion-Type and Resin-Emulsion-Type, Paste

52 W 9
Wax, Gasket-Sealing

### BUREAU OF AERONAUTICS

52 15(Aer), Amend. 2
Remover, Paint; Non-Inflammable, Water Rinsable Type

5 17(Aer), Amend. 1
Rubbing Compound (For Lacquered Surfaces)

C 1a, Amend. 1
Compound, Liquid Wax, Self-Polishing, Water-(Aircraft)

S 51
Sealant; Fuel Tank (Air Curing)

T 7
Thinner; Permanent Resin Coating

F 45b, Amend. 1
Amyl Alcohol

F 58, Amend. 1
Butyl Lactate

F 133-3a, Amend. 1
Cadmium Red

### BUREAU OF ORDNANCE

OS 1351
Paints on Exteriors of Projectiles

OS 1427, Revision C
Marking, Painting, and Greasing of Projectiles (by projectile manufacturers)

3 P9(Ord), Amend. 1
Compound, Molding, Thermosetting, Pulp Filled Preforms

52E13(Ord)
Enamel, Semi-Gloss, Rapid Drying

### BUREAU OF SHIPS

Formula No. 119
Primer, Vinyl-Red Lead Type

Formula No. 120
Primer, Vinyl-Zinc Chromate Type

Formula No. 121
Paint, Anti-Fouling, Vinyl Type

Formula No. 122
Paint, Outside, Gray (Vinyl-Alkyd Type)

### BUREAU OF SUPPLIES AND ACCOUNTS

27F14(Int)
Fabric, Impregnated, Alkyd-Resin

### BUREAU OF YARDS AND DOCKS

52P68(Int), Amend. 2
Primer, Alkyd-Resin Type

### ARMY — NAVY AERONAUTICAL SPECIFICATIONS

AN-O-A-391
Alcohol; Butyl, Normal

AN-TT-A-511
Amyl-Acetate

AN-O-B-841
Butyl-Acetate

AN-TT-C-121
Carbon-Black; Dry (Pigment)

AN-C-124a, Amend. 3
Compound; Soft-Film Corrosion-Preventive

AN-C-128a, Amend. 1
Compound; Insulating and Sealing, Electrical Connections

AN-TT-C-221
Chrome-Green; Dry (Pigment), Aircraft

AN-E-13
Enamel; Lustreless Synthetic (For Ground Equipment)

AN-O-E-758, Amend. 1
Ethyl-Acetate

AN-TT-I-676
Iron-Blue; Dry

AN-L-1a, Amend. 1
Luminescent Material; Fluorescent

AN-TT-L-116, Amend. 1
Lead-Chromate, (Pigment)

AN-P-51, Amend. 1
Petrolatum

AN-TT-R-271, Amend. 1
Resin, p-Phenyl-Phenol-Formaldehyde

AN-S-17
Sealer; Liquid, Wood

AN-TT-T-436
Titanium-Oxide; Chalk-Resisting, Dry (Pigment)

AN-R-X-876, Amend. 1
Xylene

### U. S. COAST GUARD

CGS-52E-1
Enamel, Brown

CGS-52E-2a
Enamel, Red; Gloss, Synthetic (For Aids To Navigation)

CGS-52P-2a, Amend. 2
Paint, Aluminum, Ready-Mixed

CGS-52P-3b, Amend. 1
Paint, Anti-Fouling, Vinyl-Red (Formula No. 121)

CGS-52P-4b, Amend. 1
Primer, Vinyl-Red Lead (Formula No. 119)

CGS-52-5b
Paint, Exterior, Vinyl-Alkyd Type

CGS-52P-6

CGS-52P-7a, Amend. 1
Pretreatment, Wash Primer (For Metals) (Formula No. 117)

CGS-52T-1b
Thinner (Toluene and Methyl Isobutyl Ketone)

CGS-52T-3

# SPECIFICATION CHANGES

### FEDERAL SPECIFICATIONS

| *Specification:* | *Superseded by:* |
|---|---|
| FS #87 | SS-A-701 |
| FS #424 | SS-R-451 |
| P-W-141 | P-W-158 |
| P-W-151a | Cancelled |
| TT-E-521 | TT-E-489, Color 101 |
| TT-E-531a | Cancelled |
| TT-P-101a | Cancelled |
| TT-P-146 | TT-E-487 |
| VV-P-121b (Navy-Ships) | VV-W-95 |
| JJJ-O-331 | TT-O-364 |
| JJJ-O-336 | TT-O-369 |
| JJJ-O-353 | TT-O-395 |
| LLL-T-791b | TT-T-801 |

### MILITARY SPECIFICATIONS

| *Specification:* | *Superseded by:* |
|---|---|
| JAN-L-73 | Cancelled |
| JAN-L-74 | Cancelled |
| JAN-P-121 | JAN-B-121 |
| JAN-C-237 | MIL-C-10506A |
| JAN-C-238 | MIL-C-10506A |
| MIL-W-956 (BuOrd) | Cancelled |
| JAN-W-1082 | Cancelled |
| JAN-C-1152 | Cancelled |
| MIL-P-3038 | Cancelled |
| MIL-M-3157 | MIL-STD-129 |
| MIL-B-3228 | Cancelled |
| MIL-C-4120 | MIL-C-15200 |
| MIL-T-6094 | TT-T-266 |
| MIL-T-11308 (CE) | MIL-T-704A |
| MIL-P-15036 | MIL-P-3115A |
| MIL-C-16085 (Ships) | Cancelled |
| MIL-C-20072 | Cancelled |
| MIL-P-11297(CE) | Cancelled |
| MIL-P-20200 | Cancelled |
| MIL-T-11308 | MIL-T-704B |
| MIL-E-16309(Ships) | Cancelled, Use TT-E-485 |
| MIL-V-6893 | Cancelled, Use TT-V-119 |

### DEPARTMENT OF THE AIR FORCE

| *Specification:* | *Superseded by:* |
|---|---|
| 3-100-J | MIL-F-7179 |
| 3-120-D | TT-P-381 |
| 3-168 | TT-L-54 |
| 3595 | MIL-L-6047 |
| 3596 | MIL-P-8116(USAF) |
| 3597 | Cancelled |
| 3598 | Cancelled |
| 14075 | Army 3-163 |
| 14105C | AN-L-21 |
| 14105C | MIL-L-6805A |
| 14121 | MIL-E-5558 |
| 14127 | TT-P-181 |
| 14133 | AN-C-148 |
| 14153 | MIL-S-7502(USAF) |
| 16080 | MIL-C-2535 |
| 16094E | MIL-F-4143 |
| 16120A | MIL-T-4239 |
| 16150A | JAN-C-368 |
| 20020A | 60-O-1B |
| 20023 | Cancelled |
| 3610 | MIL-S-7502 |
| 40737B | MIL-STD-129 |
| 40985A | MIL-STD-129 |

### DEPARTMENT OF THE ARMY

| *Specification:* | *Superseded by:* |
|---|---|
| 2-82C | MIL-C-11796(ORD) |
| 2-84B | MIL-C-11796(ORD) |
| 2-97 | JAN-W-1135 |
| 2-121 | MIL-C-11796(ORD) |
| 3-1F | TT-P-141 |
| 3-1F (Color Supplement) | TT-P-141 |
| 3-67 | MIL-E-10687(ORD) |
| 3-106F | JAN-P-450 |
| 3-158 | MIL-L-10287(ORD) |
| 3-160 | MIL-A-3029 |
| 3-162D | JAN-L-73 |
| 3-168 | TT-L-54 |
| 3-170A | TT-E-491 |
| 3-171 | TT-P-636 |
| 3-172 | TT-P-636 |
| 3-173 | MIL-E-11237(ArmyOrd) |
| 3-173 | AN-E-13(Air Corps) |
| 3-174 | MIL-E-11857(ORD) |
| 3-175 | TT-E-489 |
| 3-176 | TT-T-306 |
| 3-179 | TT-I-558 |
| 3-179 | TT-I-559 |
| 3-180 | TT-N-95 |
| 3-181A | TT-E-485b |
| 3-183A | JAN-P-72 |
| 3-185 | JAN-L-296 |
| 3-187A | MIL-E-20666 |
| 3-191 | JAN-E-480 |
| 3-192 | JAN-T-704 |
| 3-203 | JAN-C-168 |
| 3-208 | JAN-C-237 |
| 3-210 | MIL-V-173A |
| 3-211 | Cancelled |
| 3-213 | MIL-C-10578(Ord) |
| 3-217 | MIL-E-2052 |
| 3-218 | MIL-E-2051 |
| 4-1085 | MIL-W-2238 |
| 4-1114A | MIL-P-3324 |
| 7-27 | MIL-P-1923 |
| 7-28 | MIL-S-2062 |
| 8-51C | MIL-O-1672 |
| 8-99C | MIL-M-2063 |
| 8-108C | MIL-S-2204 |
| 8-121 | MIL-S-3005 |
| 8-139 | MIL-U-2225 |
| 8-153 | MIL-L-1994 |
| 8-154A | MIL-B-2289 |
| 8-162B | MIL-J-10801 |
| 8-164A | MIL-S-3257 |
| 8-165 | MIL-C-2049 |
| 8-166 | MIL-I-1986 |
| 8-171 | MIL-C-3355 |

| *Specification:* | *Superseded by:* |
|---|---|
| 8-173A | MIL-C-3310 |
| 8-175A | MIL-T-3312 |
| 8-181A | MIL-O-3311 |
| 8-182 | MIL-C-1993 |
| 8-184 | MIL-J-3380 |
| 9-40C | MIL-G-2122 |
| 9-63C | MIL-B-2420 |
| 9-105 | MIL-S-2462 |
| 9-107 | MIL-B-2480 |
| 9-108 | MIL-G-2050 |
| 9-110 | MIL-L-3122 |
| 29-103 | JAN-F-495 |
| 35-12 | MIL-S-1737 |
| 35-15 | JAN-S-1010 |
| 39-2 | JAN-P-629 |
| 39-3A | MIL-P-20200 |
| 39-12A | MIL-P-2018 |
| 39-13 | JAN-C-765 |
| 39-16 | MIL-A-3070 |
| 50-11-10C | JAN-C-388 |
| 50-11-17A | MIL-S-20526 |
| 50-11-44 | AN-O-E-766 |
| 50-11-48A | MIL-C-20299 |
| 50-11-76 | MIL-W-20298 |
| 50-11-92 | MIL-C-20301 |
| 50-11-147 | MIL-P-20307 |
| 52-17-20 | MIL-I-3190 |
| 52-17-21 | MIL-I-3190 |
| 57-72-6 | QQ-A-601A |
| 60-0-1B | MIL-V-3329 |
| 60-0-1B | MIL-V-3798 |
| 61-15 | MIL-P-15037A |
| 62-84 | Cancelled |
| 71-22-2A | JAN-C-173 |
| 71-49-44 | MIL-M-13231(SigC) |
| 72-84 | JAN-C-173 |
| 83-26 | MIL-S-3569 |
| 92-62 | MIL-C-1829 |
| 92-63 | MIL-C-1828 |
| 94-40645B | MIL-STD-129 |
| 97-54-275A | MIL-F-12070 |
| 100-2E | MIL-STD-129 |
| 100-19 | JAN-P-101 |
| 196-131-207 | Cancelled |
| 197-54-459 | MIL-S-3562 |

## ARMY CORPS OF ENGINEERS

| *Specification:* | *Superseded by:* |
|---|---|
| EB-511A | Army 3-186 |
| EB-674C | MIL-F-3622 |
| ES-398b | MIL-S-11090 (ORD) |
| T-1212C | Cancelled |
| T-1215D | JAN-P-630 |
| T-1224A | Army 39-36 |
| T-1225 | Cancelled |
| T-1452 | Cancelled |
| T-1690A | JAN-P-604 |
| T-1732A | Cancelled |
| T-2155 | Cancelled |
| T-2212 | Cancelled |
| T-2264A | Cancelled |
| T-2399A | MIL-L-2638 |
| T-2462 | MIL-STD-129 |

## ARMY ORDNANCE TENTATIVE SPECIFICATION

| *Specification:* | *Superseded by:* |
|---|---|
| AXS 680 | 3-162B |
| AXS 684 | 3-67E |
| AXS 736 | 3-221 |
| AXS 750 | 3-171 |
| AXS 751 | 3-172 |
| AXS 752 | 3-173 |
| AXS 753 | 3-174 |
| AXS 754 | 3-175 |
| AXS 755 | 3-175A |
| AXS 756 | 3-176 |
| AXS 821 | Cancelled |
| AXS 822 | Cancelled |
| AXS 864 | 4-1116 |
| AXS 867 | Cancelled |
| AXS 869 | Cancelled |
| AXS 883 | 3-190A |
| AXS 888 | C-G-496 |
| AXS 904 | 3-181 |
| AXS 924 | TT-P-18 |
| AXS 946 | 3-183 |
| AXS 963 | 3-184 |
| AXS 1015 | 100-34 |
| AXS 1056 | 91-99 |
| AXS 1064 | Cancelled |
| AXS 1074 | 100-19 |
| AXS 1076 | Cancelled |
| AXS 1077 | Cancelled |
| AXS 1102 | C-G-496 |
| AXS 1167 | 100-56 |
| AXS 1218 | 3-198 |
| AXS 1219 | 3-201 |
| AXS 1298 | MIL-W-3688 |
| AXS 1311 | 3-210 |
| AXS 1317 | TT-P-659 |
| AXS 1347 | MIL-C-11796 (ORD) |
| AXS 1416 | 92-61 |
| AXS 1479 | TT-X-916 |
| AXS 1544 | MIL-S-3105 |
| AXS 1605 | JAN-I-631 |
| AXS 1614 | 62-1 |
| AXS 1665 | JAN-A-397 |
| AXS 1666 | 91-99A |
| AXS 1700 | W-B-131C |
| AXS 1756 | MIL-C-3254 |
| AXS 1827 | TT-C-520 |

## ARMY ORDNANCE ROCK ISLAND ARSENAL TENTATIVE SPECIFICATIONS

| *Specification:* | *Superseded by:* |
|---|---|
| RIXS-21 | TT-R-251 |
| RIXS-57 | TT-P-636 |
| RIXS-58 | Army 3-173 |
| RIXS-68 | Army 2-84 |
| RIXS-109 | SS-A-706 |
| RIXS-119 | Obsolete |
| RIXS-120 | Army 2-82 |
| RIXS-129 | TT-E-489 |
| RIXS-173 | Army 3-173 |
| RIXS-206 | TT-E-489 |
| RIXS-225 | Cancelled |
| RIXS-233 | JAN-L-644 |
| RIXS-236 | Cancelled |
| RIXS-258 | Cancelled |
| RIXS-268 | TT-P-18 |
| RIXS-269 | Cancelled |

## ARMY QUARTERMASTER

| *Specification:* | *Superseded by:* |
|---|---|
| BQD-83 | MIL-F-1489 |
| BQD-85 | MIL-W-1510 |
| QQMG-94B | MIL-STD-129 |
| QQMG-135 | MIL-E-10164 (QMC) |
| QQMG-152A | MIL-E-10242 (QMC) |
| QQMG-166 | Cancelled |
| QQMG-167 | Cancelled |
| QQMG-179 | MIL-STD-129 |
| QQMG-180 | MIL-STD-129 |
| QQMG-219 | MIL-S-10103 (QMC) |
| PQD-256B | MIL-H-1965 |
| PQD-260A | Cancelled |
| PQD-425 | MIL-B-1960 |
| PQD-447 | CCC-T-191a |

## ARMY QM CHICAGO DEPOT

| *Specification:* | *Superseded by:* |
|---|---|
| CQD-202A | JAN-C-237 |
| CQD-202A | JAN-C-238 |
| CQD-1006 | MIL-T-1355 |

## ARMY QM JEFFERSONVILLE DEPOT

| *Specification:* | *Superseded by:* |
|---|---|
| JQD-144B | Army 29-103 |
| JQD-144B | JAN-F-495 |
| JQD-49D | MIL-C-2399 |
| JQD-214A | TT-I-558 |
| JQD-214A | TT-I-559 |
| JQD-165A | Cancelled 6/2/50 |
| JQD-1061 | MIL-E-10169 |

## ARMY QM JERSEY CITY DEPOT

| *Specification:* | *Superseded by:* |
|---|---|
| JCQD-1006 | JAN-M-661 |
| JCQD-1013 | JAN-C-1054 |

## DEPARTMENT OF THE NAVY

| *Specification:* | *Superseded by:* |
|---|---|
| 4S2 (Ord) | MIL-S-17175 (Bu Ord) |
| 17C8b | MIL-I-3374 |
| 17I15b | MIL-I-3064 |
| 27D11 | MIL-D-2905 |
| 32C14h | MIL-C-2861 |
| 32C16 | MIL-C-2908 |
| 32C23 | MIL-C-3316 |
| 33C8 | MIL-C-2910 |
| 33M5 (Ord) | MIL-P-16413 (Bu Ord) |
| 33M6 (Ord) | MIL-P-16414 (Bu Ord) |
| 40S6 (Aer) | MIL-S-974 (Aes) |
| 41P31 | MIL-P-2782 |
| 42C26 | JAN-C-237 |
| 42C32 | JAN-C-238 |
| 51A13a Type A | O-A-396 grade II |
| 51A13a " B | JAN-A-463 " 2 |
| 51A13a " C | JAN-A-463 " 6 |
| 51B3e | W-B-231 |
| 51C18b | MIL-C-20071 |
| 51C20c | P-C-431 |
| 51C37a | MIL-C-2751 |
| 51I4 | MIL-I-2179 |
| 51I5 | MIL-I-2260 |
| 51I14 | MIL-I-2175 |
| 51M6 | MIL-M-2776 |
| 51O5 | MIL-C-20207B |
| 51P16 | MIL-P-2909 |
| 51T13 | MIL-T-20618 |
| 52A1g | TT-A-468 |
| 52A10 | MIL-A-15197 (Ships) |
| 52A12a | MIL-A-15206 (Ships) |
| 52C3 (Int) | MIL-C-897 |
| 52C4c | MIL-C-15169 (Ships) |
| 52C5d | MIL-C-15200 |
| 52C7d | MIL-C-15258 (Ships) |
| 52C10 | Cancelled |
| 52C12b | MIL-C-16231 (Ships) |
| 52C13a | MIL-C-1219 |
| 52C14a | MIL-C-15204 (Ships) |
| 52C15 (Ships) | JAN-C-1154 |
| 52C16a | MIL-C-15205 (Ships) |
| 52C17 | MIL-C-15167 (Ships) |
| 52C18 (Ships) | MIL-C-972 (Ships) |
| 52C19 | Cancelled, Use MIL-C-907 |
| 52C22 | MIL-C-15199 (Ships) |
| 52C23a | MIL-C-3316 |

| *Specification:* | *Superseded by:* |
|---|---|
| 52[illegible]24 | MIL-C-2891 |
| 52[illegible]25 | MIL-C-15202 (Ships) |
| 52[illegible]26 | MIL-C-15159 (Ships) |
| 52[illegible]27 | JAN-C-168 |
| 52[illegible]28 | MIL-C-15198 (Ships) |
| 52[illegible]29a | MIL-C-2749 |
| 52[illegible]32a | MIL-C-3316 |
| 52[illegible]33 | MIL-C-15201 (Ships) |
| 52[illegible]35 (Int) | JAN-C-173 |
| 52[illegible]36 | MIL-C-2869 |
| 52[illegible]37a | MIL-C-15166 (Ships) |
| 52[illegible]40 | MIL-C-16085 |
| 52[illegible]41 (Ord) | 52C44 (Ord) |
| 52[illegible]42 | JAN-C-388 |
| 52[illegible]43 (Ships) | JAN-C-755 |
| 52[illegible]44 (Ord) | MIL-C-16555 (Bu Ord) |
| 52[illegible]45 (Ord) | MIL-C-3301 |
| 52[illegible]46 (Ships) | MIL-C-3004 |
| 52[illegible]47 (Ships) | MIL-C-15203 (Ships) |
| 52[illegible]48 (Aer) | MIL-C-5044 |
| 52D7 | TT-D-643 |
| 52D8a | TT-D-376 |
| 52D11 | MIL-D-15170 (Ships) |
| 52D13 (Ships) | MIL-D-3134 |
| 52D14 (Ships) | MIL-D-3135 |
| 52E4 | MIL-E-15090 (Ships) |
| 52E6 | JAN-E-74 |
| 52E7 | TT-E-489 |
| 52E10 (Ord) | MIL-E-16583 (Bu Ord) |
| 52E11 | MIL-C-15171 (Ships) |
| 52E12 (Ships) | MIL-E-16309 (Ships) |
| 52E14 (Ships) | MIL-E-15090 (Ships) |
| 52G5b | JAN-G-276 |
| 52K1 | TT-M-261 |
| 52L10b | JAN-L-1147 |
| 52L11a | MIL-L-15188 (Ships) |
| 52L13 | JAN-L-1118 |
| 52L14 | JAN-L-73 |
| 52L15 | Cancelled |
| 52L16 | MIL-L-15172 (Ships) |
| 52L17 | MIL-L-20209 |
| 52L18 | JAN-L-296 |
| 52L20 (Ord) | Cancelled |
| 52L21 (Ord) | Cancelled |
| 52L23 (Ord) | MIL-L-16504 (Bu Ord) |
| 52L24 (Ord) | MIL-L-16229 (Bu Ord) |
| 52L25 (Ord) | MIL-STD-603 |
| 52L26 (Aer) | MIL-L-7178 |
| 52M1b | MIL-M-15177 (Ships) |
| 52M2c | MIL-M-15173 (Ships) |
| 52M3a | MIL-M-15176 (Ships) |
| 52M4 | MIL-M-15174 (Ships) |
| 52M5 | MIL-M-15175 (Ships) |
| 52N1C | MIL-N-15178 (Ships) |
| 52O17a | MIL-O-15180 (Ships) |
| 52O18 | MIL-O-15179 (Ships) |
| 52O19b | TT-O-367 |
| 52O20 | TT-O-367 |
| 52P8c | Cancelled |
| 52P14b | Cancelled |
| 52P15a | MIL-P-15142 (Ships) |
| 52P17b | MIL-P-1227 |
| 52P18 | JAN-P-735 |
| 52P19C | MIL-P-20087 |
| 52P20 | MIL-P-15125 (Ships) |
| 52P21 | JAN-P-1115 |
| 52P22a | JAN-P-702 |
| 52P23 (Ships) | MIL-P-1232 |
| 52P24 | MIL-P-15154 (Ships) |
| 52P25 | JAN-P-1114 |
| 52P26 | Cancelled, Use JAN-P-72 |
| 52P27 | JAN-P-698 |
| 52P28a | MIL-P-2853 |
| 52P29 | MIL-P-15123 (Ships) |
| 52P30 | MIL-P-2853 |
| 52P31 | MIL-P-2934 |
| 52P32 | Cancelled |
| 52P33b | JAN-P-701 |
| 52P36 | MIL-P-2856 |
| 52P37 | MIL-P-2854 |
| 52P38a | MIL-P-20090 |
| 52P39 | MIL-P-2852 |
| 52P40a | MIL-P-15129 (Ships) |
| 52P43a | JAN-P-699 |
| 52P44a | MIL-P-15128 (Ships) |
| 52P45c | MIL-P-15130 (Ships) |
| 52P46a | MIL-P-1265 |
| 52P47 | Cancelled |
| 52P48 | JAN-P-1113 |
| 52P49 | Cancelled |
| 52P50 | Cancelled |
| 52P51 | Cancelled |
| 52P52 | MIL-P-15181 (Ships) |
| 52P53 | Cancelled |
| 52P55 | Cancelled |
| 52P56a | Cancelled |
| 52P57 (Int) | Cancelled |
| 52P58 | Cancelled |
| 52P59a | MIL-P-15143 (Ships) |
| 52P60a | MIL-P-15176 (Ships) |
| 52P61 | MIL-P-1226 |
| 52P62 | MIL-P-15144 (Ships) |
| 52P63 (Int) | JAN-P-429 |
| 52P67 | MIL-P-15145 (Ships) |
| 52P68 (Int) | Cancelled |
| 52P69 | MIL-P-20628 |
| 52P70a | MIL-P-15146 (Ships) |
| 52P71a | MIL-P-15147 (Ships) |
| 52P73a | Cancelled |
| 52P74 | Cancelled |
| 52P76 | JAN-P-72 |
| 52P77 | MIL-P-15149 (Ships) |
| 52P78 | MIL-P-15182 (Ships) |
| 52P79a | MIL-P-15183 (Ships) |
| 52P80 | Cancelled |
| 52P81 | Cancelled |
| 52P82 | JAN-P-700 |
| 52P84 | MIL-P-15150 (Ships) |
| 52P85 | MIL-P-15151 (Ships) |
| 52P86 | JAN-P-697 |
| 52P89 (Ships) | MIL-P-15152 (Ships) |
| 52P90 (Ord) | MIL-P-16406 (Bu Ord) |
| 52R10b | MIL-R-15184 (Ships) |
| 52R11 | MIL-R-15189 (Ships) |
| 52R12a | TT-R-251a |
| 52R14 | MIL-R-15190 (Ships) |
| 52S5e | MIL-S-15192 (Ships) |
| 52ST | MIL-S-15193 (Ships) |
| 52S8 (Int) | Cancelled |
| 52S9 | MIL-S-15191 (Ships) |
| 52S10 (Aer) | MIL-S-7124 |
| 52S11 (Aer) | MIL-S-7126 |
| 52T4f | Cancelled |
| 52T5a | MIL-T-15194 (Ships) |
| 52T7 | TT-T-548 |
| 52T10a | MIL-T-15195 (Ships) |
| 52T12 | TT-T-656 |
| 52V12d | MIL-V-1174 |
| 52V13g | JAN-V-1137 |
| 52V15e | MIL-V-1174 |
| 52V17 | MIL-V-15218 (Ships) |
| 52V18a | MIL-V-15218 (Ships) |
| 52V19 | MIL-V-15196 (Ships) |
| 52V20 | MIL-V-15218 (Ships) |
| 52V21 | MIL-V-15218 (Ships) |
| 52V22 | Cancelled |
| 52V23 (Ord) Class S | MIL-V-173A |
| 52V23 (Ord) Class MS | Cancelled |
| 52V24 (Ord) | Cancelled |
| 52V25 (Ord) | MIL-V-16399 (Bu Ord) |
| 52W1e | MIL-W-15234 (Ships) |
| 52W3b | JAN-W-1082 |
| 52W4b | MIL-W-15880 (Ships) |
| 52W5 | MIL-W-906 (Ships) |
| 52W7 (Ord) | Cancelled |
| 52W8 (Ord) | MIL-W-956 (Bu Ord) |
| 52W11 (Docks) | Cancelled, Use P-W-151b |
| 52X1 | TT-X-916 |
| 52Z3e | TT-Z-291 |
| 52Z7 | MIL-Z-15486 (Ships) |

## NAVY BUREAU OF AERONAUTICS

| *Specification:* | *Superseded by:* |
|---|---|
| C-47c | Cancelled |
| C-67d | MIL-R-7751A |
| C-113 | Cancelled |
| C-141 | 52R15 (Aer) |
| C-150 | MIL-C-5092 (Aer) |
| D-34 | MIL-D-7850 |
| E-13 | 52E11 |
| G-35 | MIL-A-928 (Aer) |
| G-36 | MIL-A-5090 (Aer) |
| G-37 | MIL-A-928 (Aer) |
| G-38 | MIL-A-927 (Aer) |
| L-22 | AN-L-37 |
| M-521b | MIL-P-6884 |
| M-529a | MIL-P-5054 |
| M-542 | MIL-T-6121 |
| M-559 | MIL-P-5051 |
| M-769 | MIL-L-6047 |
| M-773 | 52R17 (Aer) |
| PF-9e | MIL-P-6808 |
| PF-14 | MIL-E-7851 |
| RM-5c | AN-C-89 |
| RM-11c | JJJ-O-336 |
| SR-15e | MIL-F-7179 |
| W-52 | 52C48 (Aer) |

## NAVY BUREAU OF ORDNANCE

| *Specification:* | *Superseded by:* |
|---|---|
| OS815 | JAN-P-450 |
| OS848 | 52C42 |
| OS863 | 52P90 (Ord) |
| OS1210 | Cancelled |
| OS1352 | 52E13 (Ord) |
| OS1356 | JAN-P-450 |
| OS1433 | 52V25 (Ord) |
| OS1549 | JAN-P-450 |
| OS1555 | 33M6 (Ord) |
| OS1586 | 33M5 (Ord) |
| OS1590 (Rev A) | 52E13 (Ord) |
| OS1645 | MIL-S-17175 (Bu Ord) |
| OS1653 | 33C9 (Ord) |
| OS1658 | MIL-A-3167 |
| OS1668 | 52L23 (Ord) |
| OS2530 | 33R15 (Ord) |
| OS3938 | 52T15 (Ord) |
| OS3949 | 52V23 (Ord) |
| OS3950 | 52L20 (Ord) |
| OS3951 | 52V24 (Ord) |
| OS3952 | 52L21 (Ord) |
| OS3953 | 52W7 (Ord) |
| OS3954 | 52W8 (Ord) |

## ARMY-NAVY AERONAUTICAL SPECIFICATIONS

| *Specification:* | *Superseded by:* |
|---|---|
| AN-A-17 | Cancelled |
| AN-A-18 | MIL-A-6091 |
| AN-A-45 | MIL-A-5534 |
| AN-A-46 | MIL-A-5535 |
| AN-TT-A-461a | TT-A-468 |
| AN-C-52b | MIL-C-6708 |

| *Specification:* | *Superseded by:* |
|---|---|
| AN-C-54a | MIL-C-5539 |
| AN-C-83a | MIL-C-6796 |
| AN-C-86b | MIL-C-5542 |
| AN-C-89 | MIL-C-5537 |
| AN-C-142 | MIL-C-6798 |
| AN-C-145 | MIL-P-3038 |
| AN-C-148 | MIL-R-3043 |
| AN-C-169 | MIL-C-5540 |
| AN-C-170 | MIL-C-5541 |
| AN-L-C-181 | MIL-C-5538 |
| AN-TT-C-516 | Cancelled, Use TT-P-141b & TT-P-143 |
| AN-VV-C-576b | MIL-C-7853 |
| AN-D-1a | MIL-D-5549 |
| AN-D-2a | MIL-D-5551 |
| AN-D-3a | MIL-D-5550 |
| AN-D-8 | MIL-D-5555 |
| AN-D-14 | TT-D-291 |
| AN-TT-D-514 | MIL-D-5553 |
| AN-TT-D-551 | MIL-D-5552 |
| AN-TT-D-554 | MIL-D-5554 |
| AN-TT-D-643 | TT-D-643 |
| AN-E-3a | MIL-E-7729 |
| AN-E-4a | MIL-E-6802 |
| AN-E-7a | MIL-E-5556 |
| AN-E-51 | MIL-E-5558 (for Navy) |
| AN-E-51 | AN-E-4a (for Air Force) |
| AN-TT-E-501 | MIL-E-5557 |
| AN-O-E-766 | MIL-E-7910 |
| AN-L-13a | MIL-L-6770 |
| AN-L-21a | MIL-L-6805 |
| AN-L-29a | MIL-L-7178 |
| AN-L-37 | MIL-C-6806 |
| AN-M-5 | TT-M-261 |
| AN-M-13A (in Part) | MIL-STD-129 |
| AN-N-3 | TT-N-95 |
| AN-VV-N-96 | TT-N-97 |
| AN-JJJ-O-354 | TT-O-395 |
| AN-P-31a | MIL-P-6883 |
| AN-P-49 | MIL-P-6890 |
| AN-P-73 | Cancelled, Use JAN-P-72 |
| AN-P-85 | MIL-P-6884 |
| AN-P-656 | MIL-P-6889 |
| AN-P-658 | MIL-P-6889 |
| AN-S-55 | MIL-P-6892 |
| AN-T-8b | TT-T-548 |
| AN-T-27 | MIL-T-6096 |
| AN-T-28 | MIL-T-6097 |
| AN-T-30a | TT-T-656 |
| AN-T-93 | MIL-T-6121 |
| AN-TT-T-256 | MIL-T-6094 |
| AN-TT-T-258 | MIL-T-6095 |
| AN-T-258 | MIL-T-6095 |
| AN-R-T-541 | TT-T-548 |

| *Specification:* | *Superseded by:* |
|---|---|
| AN-TT-T-561 | TT-T-562 |
| AN-V-26 | MIL-V-6893 |
| AN-V-27 | MIL-V-6895 |
| AN-V-29 | MIL-V-6093 |
| AN-TT-V-116 | MIL-V-6894 |

## MARITIME COMMISSION

| *Specification:* | *Superseded by:* |
|---|---|
| 52-MC-33 | 52-MC-524 |
| 52-MC-11 | 52-MC-523 |
| 52-MC-10 | 52-MC-522 |
| 52-MC-16 | 52-MC-521 |
| 52-MC-8 | 52-MC-520 |
| 52-MC-21 | 52-MC-501 |
| 52-MC-14 | 52-MC-304 |
| 52-MC-6 | 52-MA-251 |
| 52-MC-17 | 52-MA-210 |
| 52-MC-18 | 52-MA-203 |
| 52-MC-29 | 52-MA-202 |
| 52-MC-26 | 52-MA-155 |
| 52-MC-34 | 52-MC-120 |
| 52-MC-30 | 52-MC-107 |
| 52-MC-32 | 52-MC-105 |

## TENNESSEE VALLEY AUTHORITY

| *Specification:* | *Superseded by:* |
|---|---|
| A-76 | Obsolete |
| A-79 | " |
| A-80 | " |
| A-81 | " |
| A-82 | " |
| A-83 | " |
| A-84 | " |
| A-86 | " |
| A-87 | " |
| A-94 | " |
| A-95 | " |
| A-96 | " |
| C-43A | " |
| C-44 | " |
| C-46 | " |
| C-47 | " |
| C-48 | " |
| C-73 | " |
| C-77 | " |
| C-100 | " |
| C-101 | " |
| M-9 | " |
| M-67 | " |
| 103 | " |

# APPENDIX

# BOOKS PUBLISHED IN 1954

**Accounting and Costing In the Paint Industry**

*Paint Materials Trade Ass'n. (England) Business Book Co., 481 University Ave., Toronto 2, Ontario, Canada*

**Carbon Blacks for Protective And Decorative Coatings**

*L. J. Venuto. Binney & Smith, Inc., 380 Madison Ave., New York 17, N. Y.*

In this book, Mr. Venuto has attempted "to bring together some of the useful knowledge that has been gained and to place it before our friends in the protective and decorative coatings industry in such manner as to make it available for reference purposes". It is also designed as an aid in the selection of the particular Binney & Smith Co.'s carbon black most suited for the specific application.

**The Chemistry and Processing Of Alkyd Resins**

*Published by Monsanto Chemical Co., St. Louis, Mo., 90 pages, Price $2.50.*

A study of the processing variables and fundamental chemical reactions that comprise the basic techniques of making alkyd resins.

The chief purpose of the book is to collect into a single volume, practical data on materials, equipment and operation which are basic to the production of this type of resin.

In each instance, typical formulations have been cited as examples of a given type of alkyd resin.

**Fisher/Tag Manual for Inspectors of Petroleum**

*Published by Fisher Scientific Co., 717 Forbes St., Pittsburgh, Pa., 28th Edition, 220 pages, Price $1.75*

This manual gives all the essential details for 35 of the most widely used tests for the basic physical and chemical properties of petroleum and its products, such as gravity, color, viscosity, distillation range, vapor pressure, gum content, sulfur, carbon residue, flash point, water and sediment, melting point, cloud and pour points, consistency.

**Monomeric Acrylic Esters**

*By E. H. Riddle, Reinhold Publishing Corp., 430 Park Ave., New York 22, N. Y., 230 pages, Price $5.00.*

Written by a group of research chemists and chemical Engineers at Rohm & Haas Company, this book provides a wealth of up-to-date information on commercially available acrylate and methacrylate esters.

**Organic Coating Technology—Vol. I Oils, Resins, Varnishes and Polymers**

*By H. F. Payne. John Wiley & Sons, Inc., 440 Fourth Ave., New York 16, N. Y., 674 pages, Price $10.00.*

This book fills the long-felt need for a comprehensive but concise work surveying the chemistry, manufacture, and applications of the oils, resins, varnishes, and high polymers used in organic coatings. The book places emphasis on the practical rather than the theoretical aspects and contains many specific formulations based on representative commercial products called by their trade names.

**Practical Paint Course**

*Published by American Paint Journal Co., 3713 Washington Ave., St. Louis 8, Mo., 222 pages.*

A series of lectures presented at the Decennial Practical Paint Course conducted by the New England Paint & Varnish Production Club, at Baker Memorial Auditorium, Harvard Graduate School of Business Administration.

**Solvents Manual**

*By C. Marden. The Elsevier Press, 402 Lovett Blvd., Houston, Texas, 440 pages, Prcie $12.95.*

Comprehensive, accurate, quick—reference guide to industrial solvents. Included is a large (22½ x 35") solubility chart showing actions of 250 organic solvents on about 150 solutes of current industrial importance.

**Statistical Analysis in Chemistry And the Chemical Industry**

*By C. A. Bennett & N. L. Franklin. John Wiley & Sons, Inc., 440 Fourth Ave., New York 16, N. Y., 724 pages, Price $8.00.*

Sponsored by the Committee on Applied Mathematical Statistics of the National Research Council, this book provides a development of those aspects of applied mathematical statistics of greatest use to chemists and chemical engineers.

**Technology of Solvents And Plasticizers**

*A. K. Doolittle. John Wiley & Sons, Inc., 440 Fourth Ave., New York 16, N. Y., 1056 pages, Price $18.50.*

This work represents a complete treatise on the subjects of solvents and plasticizers and is intended as reference for those engaged in the field of paints, varnishes, lacquers, adhesives, inks, synthetic textiles, and plastics.

**What You Should Know About Paint**

*By E. M. Fisher. Schnell Publishing Co., Inc., 30 Church St., New York 7, N. Y., Price $2.50.*

As the author points out in the preface, this book was written with the intention of helping non-technical people engaged in the distribution, sale and use of today's paint products. The pace with which the paint industry has progressed technologically over the past decade has pointed up the need of a reference which presents, in the simplest way possible, the technical developments having taken place during this period and the effect that such developments have had on the various segments of the paint industry.

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AC-2
Polarographic analysis of Lead Driers—D. A. Skoog & R. L. Focht. Vol. 25, #12, Dec. 1953, p1922-1924. 36.2.2

AC-3
Electron Microscopy—M. Swerdlow. Vol. 26, #1, Jan. 1954, p34-42. 50.6.2

AC-4
Roman Spectroscopy—R. F. Stamm. Vol. 26, #1, Jan. 1954, p49-53. 50.9.2

AC-5
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AC-7
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AC-8
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AC-9
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AC-10
Some Aspects of Microscopy in Cellulose Research —M. L. Rollins. Vol. 26, #4, April 1954, p718-724. 5.1.11

AC-11
Analysis Data For the Ternary System Isopropyl Alcohol—Isopropyl Ether-Water—W. S. Brey, Jr. Vol. 26, #5, May 1954, p838-842. 34.4.4

AC-12
Determination of Particle Size Distribution in GR-S Latices—A. Nisonoff, W. E. Messer, & L. H. Howland. Vol. 26, #5, May 1954, p856-861. 19.6.1

AC-13
Evaluation of Test Procedures—D. S. McArthur, E. L. Baldeschwieler, W. H. White, & J. S. Anderson. Vol. 26, #6, June 1954, p1012-1018. 50.4.7

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AC-17
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APJ-1
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APJ-2
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APJ-3
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APJ-10
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APJ-13
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APJ-28
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APJ-30
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APJ-31
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U. S. Patent 23,722. Ralph E. Pike, Flint, Mich., assignor to E. I. du Pont de Nemours and Company, Wilmington, Del., a corporation of Delaware. Original No. 2,604,414, dated July 22, 1952. (39.1.26

USP-2
**Color Blending**
U. S. Patent 2,642,404. Ralph E. Pike, Media, Pa., assignor to E. I. du Pont de Nemours & Company, Wilmington, Del., a corporation of Delaware. 39.1.27

USP-3
**Tall Oil-Polyamino-Aldehyde Products**
U. S. Patent 2,640,814. Alfred F. Schmutzler, Stamford, Conn., assignor to American Cyanamid Company, New York, N. Y., a corporation of Maine. 9.1.3

USP-4
**Polyacrylic Nitrile Process**
U. S. Patent 2,642,418. Heinrich Wenning, Marl in Westphalia, Germany, assignor to Chemische Werke Gesellschaft mit beschrankter Haftung, Kreis Recklinghausen, Germany, a corporation of Germany. 44.2.16

USP-5
**Sulfonated Aryl Acetylene Resins**
U. S. Patent 2,644,801. Gaetano F. D'Alelio, Pittsburgh, Pa., assignor to Koppers Company, Inc., a corporation of Delaware. 8.1.8

USP-6
**Polyvinyl Acetal Resins**
U. S. Patent 2,644,807. Herman S. Bloch, Chicago, Ill., assignor to Universal Oil Products Company, Chicago, Ill., a corporation of Delaware. 18.6.1

USP-7
**Thixotropic Coating**
U. S. Patent 2,645,626. Birger W. Nordlander and Robert E. Burnett, Schenectady, N. Y., assignors to General Electric Company, a New York corporation. 17.1.15

USP-8
**Vinyl Polysiloxane**
U. S. Patent 2,645,628. Dallas T. Hurd, Burnt Hills, N. Y., assignor to General Electric Company, a corporation of New York. 15.1.26

USP-9
**Hydrocarbon Drying Oils**
U. S. Patent 2,645,649. Alfred E. Hoffman, Clarendon Hills, Ill., assignor to Universal Oil Products Company, Chicago, Ill., a corporation of Delaware. 35.9.4

USP-10
**Maleic Polyester Compositions**
U. S. Patent 2,646,410. Joseph Wayne Kneisley, Marshallton, Del., assignor to Hercules Powder Company, Wilmington, Del., a corporation of Delaware. 17.1.16

USP-11
**Pigment Paste**
U. S. Patent 2,647,094. Frank J. Hahn, Springfield, Mass., assignor to Monsanto Chemical Company, St. Louis, Mo., a corporation of Delaware. 33.1.2

USP-12
**Alkyd Resin**
U. S. Patent 2,647,095. Carl J. Opp and Raymond E. Werner, Cincinnati, Ohio, assignors to Interchemical Corporation, New York, N. Y., a corporation of Ohio. 4.1.10

USP-13
**Vinyl Transparent Film**
U. S. Patent 2,647,101. Bingham J. Humphrey, Mount Carmel, Conn., and Robert J. Reid, Canal Fulton, Ohio, assignors to The Firestone Tire & Rubber Company, Akron, Ohio, a corporation of Ohio. 18.1.17

USP-14
**Copolymers of Vinyl Phenols With Drying Oils**
U. S. Patent 2,647,876. Edward Michael Evans, Tonbridge, and Stanley Erwin Bradshaw, Tunbridge Wells, England, and John Edward Seager Whitney, Penarth, Wales, assignors to British Resin Products Limited, London, England, a British company. 13.1.4

USP-15
**Promoting Polymerization**
U. S. Patent 2,647,878. Max M. Lee, Washington, D. C. 44.2.17

USP-16
**Silicone Lacquers**
U. S. Patent 2,647,880. Siegfried Nitzche, Burghausen, Upper Bavaria, Germany, assignor, by mesne assignments, to Wacker-Chemie G. m. b. H., Munich, Germany. 15.1.27

USP-17
**Lacquer Containing Hydrocarbon Resin**
U. S. Patent 2,648,640. Herman S. Bloch, Chicago, Ill., assignor to Universal Oil Products Company, Chicago, Ill., a corporation of Delaware. 39.1.28

USP-18
**Fire Retardant Coating**
U. S. Patent 2,648,641. John E. Robison, Warren, Oreg., assignor to Fir-Tex Insulating Board Co., St. Helens, Oreg., a corporation of Oregon. 38.4.2

USP-19
**Medium Oil Alkyd**
U. S. Patent 2,648,642. Frank R. Spencer, Stamford, Conn., assignor to American Cyanamid Company, New York, N. Y., a corporation of Maine. 4.1.11

USP-20
**AZO Pigment**
U. S. Patent 2,649,383. Donald B. Killian, Nutley, N. J., and Albert D. Reidinger, Wilmington, Del., assignors to E. I. du Pont de Nemours & Company, Wilmington, Del., a corporation of Delawar 21.1.17

USP-21
**Phenolic Ester Resins**
U. S. Patent 2,649,422. David Aelony, Minneapolis, Minn., assignor to General Mills, Inc., a corporation of Delaware. 13.1.5

USP-22
**Short Oil Modiffed Alkyd**
U. S. Patent 2,649,423. Frank R. Spencer, Stamford, Conn., assignor to American Cyanamid Company, New York, N. Y., a corporation of Main 4.1.12

USP-23
**Protective Coating**
U. S. Patent 2,649,424. Benson G. Brand, Columbus, Ohio, assignor, by mesne assignments, to T Battelle Development Corporation, Columbu Ohio, a corporation of Delaware. 39.1.29

USP-24
**Melamine Resin**
U. S. Patent 2,649,446. Raymond A. Vinge Stamford, Conn., assignor to Allied Chemical Dye Corporation, New York, N. Y., a corporatio of New York. 9.2.2

USP-25
**Mixing Luminescent Coatings**
U. S. Patent 2,650,199. Jerome J. O'Callaghan Skokie, Ill., assignor to The Rauland Corporation a corporation, of Illinois. 46.2.6

USP-26
**Synthetic Drying Oils**
U. S. Patent 2,650,209. Joseph F. Nelson, Rahway, and Anthony H. Gleason, Westfield, N. J., assignors to Standard Oil Development Company, a corporation of Delaware. 35.9.5

USP-27
**Styrene Copolymer**
U. S. Patent 2,650,907. James H. Sample, Chicago, Ill., assignor to The Sherwin-Williams Company, Cleveland, Ohio, a corporation of Ohio. 16.1.23

USP-28
**Coating Compositions**
U. S. Patent 2,650,909. Carl L. Betsch and Fred H. Detrick, Philadelphia, Pa. 39.1.30

USP-29
**Water-Soluble Urea-Aldehyde Products**
U. S. Patent 2,650,910. Franz Kohler, Alsbach (Bergstrasse), Germany, assignor to Deutsche Gold- und Silber-Scheideanstalt vormals Roessler, Frankfurt am main, Germany, a corporation of Germany. 9.3.1

USP-30
**Setting Protein Coatings With Ammonium**
U. S. Patent 2,652,345. Jean E. Jones, Rochester, N. Y., assignor to Eastman Kodak Company, Rochester, N. Y., a corporation of New Jersey. 39.1.31

USP-31
**Gel Lacquer**
U. S. Patent 2,652,346. Ralph E. Porzer, Bloomfield, N. J., and Alan P. Baruch, Stamford, Conn., assignors to Celanese Corporation of America, a corporation of Delaware. 39.1.32

USP-32
**Synthetic Drying Oil**
U. S. Patent 2,652,342. Anthony H. Gleason, Westfield, N. J., assignor to Standard Oil Development Company, a corporation of Delaware. 35.9.6

USP-33
**Polyester Resins**
U. S. Patent 2,652,383. John F. Davis, Stamford, Conn., assignor to American Cyanamid Company, New York, N. Y., a corporation of Maine. 17.1.17

USP-34
**Ester Resins**
U. S. Patent 2,653,142. William P. Cody, Lombard, and Edgar L. Clark, Cicero, Ill., assignors to Alkydol Laboratories, Inc., Cicero, Ill., a corporation of Illinois. 4.1.13

USP-35
**Polyvinyl Methyl Ether**
U. S. Patent 2,653,923. Joseph F. Shekleton, Easton, Pa., assignor to General Aniline & Film Corporation, New York, N. Y., a corporation of Delaware. 18.1.18

USP-36
**Plasticized Vinyl Chloride**
U. S. Patent 2,653,948. Joachim Dazzi, Dayton, Ohio, assignor to Monsanto Chemical Company, St. Louis, Mo., a corporation of Delaware. 18.3.5

USP-37
**Drying Oil Compositions**
U. S. Patent 2,653,956. Edwin G. Marhofer, Fredonia, Kans., and John C. Hillyer, Bartlesville, Okla., assignors to Phillips Petroleum Company, a corporation of Delaware. 35.9.7

USP-38
**Stabilized Vinyl Resin**
U. S. Patent 2,654, 718. Oliver J. Grummitt and Robert E. Blank, Cleveland, and Dean Marsh, Cleveland Heights, Ohio, assignors to The Sherwin-Williams Company, Cleveland, Ohio, a corporation of Ohio. 18.1.19

USP-39
**Luminescent Resins**
U. S. Patent 2,654,732. Edward M. Geiser, Downers Grove, Ill., assignor to Universal Oil Products Company, Chicago, Ill., a corporation of Delaware. 2.1.28

USP-40
**Tetrahydrophthalic Alkyd Resins**
U. S. Patent 2,655,486. Alexander C. Keyl, Bensenville, and Robert H. Geils, Downers Grove, Ill., assignors to Fred'k A. Stresen-Reuter, Inc., a corporation of Illinois. 4.1.14

USP-41

**Polyethylene-Silicone Coating**

U. S. Patent 2,655,489. William Dent Lawson, Springfield, Pa., assignor to E. I. Du Pont de Nemours and Company, Wilmington, Del., a corporation of Delaware. 15.1.28

USP-42

**Catalytic Hardening of Phenolic Resins**

U. S. Patent 2,655,490. Lawrence F. Sonnabend and Alvin M. Edmunds, Midland, Mich., assignors to The Dow Chemical Company, Midland, Mich., a corporation of Delaware. 13.1.6

USP-43

**Alkyl Titanates**

U. S. Patent 2,655,523. Daniel F. Herman, Queens, N. Y., assignor to National Lead Company, New York, N. Y., a corporation of New Jersey. 2.2.3

USP-44

**Pigment Paste**

U. S. Patent 2,656,327. Alfred E. Van Wirt and George F. Jones, Glens Falls, N. Y. assignors to Imperial Paper and Color Corporation, a corporation of New York. 33.1.3

USP-45

**Synthetic Resin**

U. S. Patent 2,656,335. Herman S. Bloch, Chicago, Ill., assignor to Universal Oil Products Company, Chicago, Ill., a corporation of Delaware. 2.1.29

USP-46

**Corrosion-Resistant Paint**

U. S. Patent 2,657,145. Arthur Arent, Fort Dodge, Iowa, assignor to Arthur Arent Laboratories Inc., Des Moines, Iowa, a corporation of Iowa. 39.3.33

USP-47

**Zein Solution**

U. S. Patent 2,657,148. Joseph R. Ehrlich, New York, N. Y. 36.9.2

USP-48

**Insoluble Coating**

U. S. Patent 2,657,155. Jan Lolkema, Hoogezand, Netherlands, assignor to Naamlooze Venootschap: W. A. Scholten's Chemische Fabrieken, Groningen, Netherlands, a corporation of the Netherlands. 39.1.33

USP-49

**Blends of Elastomers With Phenolics**

U. S. Patent 2,657,185. David W. Young, Roselle, and Raymond G. Newberg, Cranford, N. J., assignors to Standard Oil Development Company, a corporation of Delaware. 8.7.2

USP-50

**Polyvinyl Chloride Resin**

U. S. Patent 2,657,186. David X. Klein, Passaic, and Mark N. Curgan, Clifton, N. J., assignors to Heyden Chemical Corporation, New York, N. Y., a corporation of Delaware. 18.3.6

USP-51

**Oleffn-Vinyl Acetate Copolymers**

U. S. Patent 2,657,188. Walter A. Denison, South Charleston, and William N. Stoops, Charleston, W. Va., assignors, by mesne assignments, to Union Carbide and Carbon Corporation, a corporation of New York. 18.2.4

USP-52

**Stabilized Stains**

U. S. Patent 2,657,970. Lawrence Rudick, Longmeadow, Mass., assignor to Monsanto Chemical Company, St. Louis, Mo., a corporation of Delaware. 21.3.3

USP-53

**Multicolor Coating**

U. S. Patent 2,658,002. Melvin Schwefsky, Union N. J., assignor to United Lacquer Mfg. Corp., Linden, N. J., a corporation. 40.1.14

USP-54

**Coating Composition**

U. S. Patent 2,658,003. Louis E. Klein, St. Louis, Mo., and August R. Hempel, Dayton, Ohio, assignors to Monsanto Chemical Company, St. Louis, Mo., a corporation of Delaware. 39.1.34

USP-55

**Protection of Metal Surfaces**

U. S. Patent 2,658,834. Carl A. M. Rex, Hoboken, N. J., assignor of one-half to Jack F. Govan and one-half to Roy H. Govan, both of Hoboken, N. J. 39.3.34

USP-56

**Sizing Medium**

U. S. Patent 2,658,835. Roy P. Wymbs, Fredericksburg, Va., assignor to American Viscose Corporation, Wilmington, Del., a corporation of Delaware. 39.2.6

USP-57

**Preparation of Melamine**

U. S. Patent 2,658,891. Johnstone S. Mackay, Old Greenwich, Conn., assignor to American Cyanamid Company, New York, N. Y., a corporation of Maine. 37.1.5

USP-58

**Melamine From Biuret**

U. S. Patent 2,658,892. Joseph H. Paden, Stamford, and Johnstone S. Mackay, Old Greenwich, Conn., assignors to American Cyanamid Company, New York N. Y., a corporation of Maine. 37.1.6

USP-59

**Hydrolyzable Siloxanes**

U. S. Patent 2,658,908. Siegfried Nitzsche and Ewald Pirson, Burghausen, Upper Bavaria, Germany, assignors, by mesne assignments, to Wacker-Chemie G. m. b. H., Munich, Germany. 15.1.29

USP-60

**Pouring Attachment For Paint Cans**

U. S. Patent 2,659,519. John W. Allen, Detroit, Mich. 47.1.8

USP-61

**Linear Polyamides**

U. S. Patent 2,659,713. Eugene Edward Magat, Wilmington, Del., assignor to E. I. Du Pont de Nemours and Company, Wilmington, Del., a corporation of Delaware. 11.1.4

USP-62

**Alkoxy Silane Liquid**

U. S. Patent 2,660,538. Harold Garton Emblem, St. Helens, England, Clifford Shaw, Johannesburg, Transvaal, Union of South Africa, and William Edwin Langrish-Smith, Burwash Common, England; said Emblem assignor to said Shaw and said Langrish-Smith. 15.1.30

USP-63

**Synthetic Resin**

U. S. Patent 2,660,573. Williard J. Lantz, Emmaus, and Joseph M. Walters, Allentown, Pa., assignors to Electro-Chemical Engineering & Mfg. Co., Emmaus, Pa., a corporation of Delaware. 13.1.7

USP-64

**Lactic Casein Solution**

U. S. Patent 2,662,026. Karl B. Daniloff, Seattle, Wash., assignor to Monsanto Chemical Company, St. Louis, Mo., a corporation of Delaware. 40.1.15

USP-65

**Polychromatic Coating**

U. S. Patent 2,662,027. Ralph E. Pike, Valley, Pa., assignor to E. I. du Pont de Nemours & Company, Wilmington, Del., a corporation of Delaware. 39.1.35

USP-66

**Preparation of Soldered Metal Surface for Painting**

U. S. Patent 2,662,838. Gerald E. Owen, Detroit, and William Suter, Melvindale, Mich., assignors to Kaizer-Frazer Corporation, Willow Run, Mich., a corporation of Nevada. 41.1.17

USP-67

**Treating Tall Oil**

U. S. Patent 2,662,849. Emmett P. Glynn, Chicago, Ill., and Burt F. Hofferth, Ames, Iowa, assignors to Armour and Company, Chicago, Ill., a corporation of Illinois. 35.8.7

USP-68

**Drying Alkyd Resin**

U. S. Patent 2,662,862. Willie W. Crouch, Bartlesville, Okla., assignor to Phillips Petroleum Company, a corporation of Delaware. 4.1.15

USP-69

**Emulsion Polymerization Of Vinyl Acetate**

U. S. Patent 2,662,863. John E. Bristol, Niagara Falls, Warren A. Harrington, Wilson, and Norris Turnbull, Grand Island, N. Y., assignors to E. I. du Pont de Nemours & Company, Wilmington, Del., a corporation of Delaware. 19.4.8

USP-70

**Polyamide-Phenolic Coating**

U. S. Patent 2,662,865. David N. Beauchamp, Whittier, Calif., assignor to The Sherwin-Williams Company, Cleveland, Ohio, a corporation of Ohio. 11.1.5

USP-71

**Concealing Defects In a Surface**

U. S. Patent 2,663,651. Alfred E. Kowall, Westchester, Ill., assignor of one-half to Edward A. Kirwin, Wilmington, Del. 41.1.18

USP-72

**Coating With Polyethylene**

U. S. Patent 2,663,652. Wilford E. Railing, Penns Grove, N. J., assignor to E. I. du Pont de Nemours and Company, Wilmington, Del., a corporation of Delaware. 12.1.7

USP-73

**Preparing Novolaks**

U. S. Patent 2,663,699. Herman Bloem and Marinus Stel, Eindhoven, Netherlands, assignors to Hartford National Bank and Trust Company, Hartford, Conn., as trustee. 13.1.8

USP-74

**Chlorinated Latex Aqueous Coating**

U. S. Patent 2,663,747. Petrus Ten Have, Wijk Maastricht, Netherlands, assignor to Rubber-Stichting, Delft, Netherlands. 19.5.1

USP-75

**Rust Inhibiting Composition**

U. S. Patent 2,665,995. John W. Bishop, Plainfield, N. J., assignor to Tide Water Associated Oil Company, Bayonne, N. J., a corporation of Delaware. 39.3.35

USP-76

**Stabilizing and Plasticizing Vinylidene Chloride Resins**

U. S. Patent 2,666,039. Robert J. Reid, Canal Fulton, and William Mayo Smith, Jr., Cuyahoga Falls, Ohio, assignors to The Firestone Tire & Rubber Company, Akron, Ohio, a corporation of Ohio. 36.8.3

USP-77

**Heat Stabilization of Vinylidene Chlorides**

U. S. Patent 2,666,040. Chris E. Best, Franklin Township, Summit County, Ohio, assignor to The Firestone Tire & Rubber Company, Akron, Ohio, a corporation of Ohio. 36.8.4

USP-78

**Tarnish-Resistant Bronze Powder**

U. S. Patent 2,666,714. Joseph Halberstadt, Malone, N. Y., assignor to Malone Bronze Powder Works Inc., Malone, N. Y. 30.1.1

USP-79

**Determining and Mixing Colors**

U. S. Patent 2,666,715. Otto Syreeni, Helsinki, Finland. 21.2.8

USP-80

**Self-Extinguishing Asphalt**

U. S. Patent 2,667,425. Lester A. Bierly, Chautauqua, N. Y., assignor to Presque Isle Laboratories and Manufacturing, Inc., Erie, Pa., a corporation of Pennsylvania. 8.6.6

USP-81

**Vinyl Esters of Hydro-Carbonsulfonic Acid**

U. S. Patent 2,667,469. John C. Sauer, Wilmington, Del., assignor to E. I. du Pont de Nemours and Company, Wilmington, Del., a corporation of Delaware. 18.1.20

USP-82

**Shortstopping of Butadiene Styrene Emulsion Polymerization**

U. S. Patent 2,667,472. Robert W. Brown, Naugatuck, Conn., assignor to United States Rubber Company, New York, N. Y., a corporation of New Jersey. 44.2.18

USP-83

**Water-Soluble Films**

U. S. Patent 2,668,120. Clyde W. Leaf and Lawrence M. Liggett, Wyandotte, Mich., assignors to Wyandotte Chemicals Corporation, Wyandotte, Mich., a corporation of Michigan. 5.6.4

USP-84

**Lead Chromate-Lead Silicate Pigment**

U. S. Patent 2,668,122. Adrian R. Pitrot, Uniondale, N. Y., assignor to National Lead Company, New York, N. Y., a corporation of New Jersey. 32.2.3

USP-85

**Resinous Copolymers**

U. S. Patent 2,668,164. Gilbert H. Swart, Akron, and Theodore A. T Grotenhuis, Olmsted Falls, Ohio, assignors to The General Tire and Rubber Company, Akron, Ohio, a corporation of Ohio. 16.1.24

USP-86

**Whitening Agents For Organic Materials**

U. S. Patent 2,668,777. Heinrich Gold, Opladen, and Siegfried Petersen, Leverkusen-Schlebusch, Germany, assingors to Farbenfabriken Bayer Aktiengesellschaft, Leverkusen, Germany, a corporation of Germany. 36.1.2

USP-87

**Vinyl Coating**

U. S. Patent 2,668,801. Arthur Charles Schultz, Ross Township, Allegheny County, Pa., assignor to Stoner-Mudge, Inc., Pittsburgh, Pa., a corporation of Pennsylvania. 39.1.36

USP-88

**Vinyl Phenol-Aldehyde Resins**

U. S. Patent 2,668,802. Edward Michael Evans and John Edward Seager Whitney, Tonbridge, England, assignors to British Resin Products Limited, London, England, a British company. 13.1.9

USP-89

**Phenol-Epoxide Compositions**

U. S. Patent 2,668,805. Sylvan Owen Greenlee, Racine, Wis., assignor to Devoe & Raynolds Company, Inc., Louisville, Ky., a corporation of New York. 13.1.10

USP-90

**Suspension Polymerization Process**

U. S. Patent 2,668,806. Robert N. Haward and Joyce Elly, Trafford Park, Manchester, England, assignors, by mesne assignments, to Styrene Products Limited, London, England. 44.2.19

USP-91

**Epoxide Compositions**

U. S. Patent 2,668,807. Sylvan Owen Greenlee, Racine, Wis., assignor to Devoe & Raynolds Company Inc., Louisville, Ky., a corporation of New York. 6.1.15

USP-92

**High Viscosity Polyvinyl Alcohol**

U. S. Patent 2,668,809. Harold W. Bryant, Kenmore, N. Y., and William R. Cornthwaite, Wilmington, Del., assignors to E. I. du Pont de Nemours & Company, Wilmington, Del., a corporation of Delaware. 18.5.1

USP-93

**Enamel With Stabilized Drying Rate**

U. S. Patent 2,669,526. Donald F. Koenecke, Elizabeth, and John F. McKay, Jr., Cranford, N. J., assignors to Standard Oil Development Company, a corporation of Delaware. 39.1.37

USP-94

**Treating Cashew Nut Shell Liquid**

U. S. Patent 2,669,554. Clifford F. Armitage, South Orange, N. J., assignor to Colloid Chemical Laboratories, Inc., Cedar Knolls, N. J., a corporation of New Jersey. 13.1.11

USP-95

**Producting Phthalocyanine**

U. S. Patent 2,669,569. Thomas D. Mutaffis, North Plainfield, N. J., assignor to American Cyanamid Company, New York, N. Y., a corporation of Maine. 27.3.1

USP-96

**Bodying Catalysts For Drying Oils**

U. S. Patent 2,669,573. Earl E. Parker, Milwaukee, Wis., assignor to Pittsburgh Plate Glass Company, Allegheny County, Pa., a corporation of Pennsylvania. 36.2.6

USP-97

**Test Apparatus For Oils**

U. S. Patent 2,669,865. Joseph Cole, Whiting, Ind., and John Krawetz, Evanston, Ill. 50.3.8

USP-98

**Fire Retardant Solution**

U. S. Patent 2,670,297. Roy Dahlstrom, Westfield, and George E. Bronson, Matawan, N. J., assignors to National Lead Company, New York, N. Y., a corporation of New Jersey. 36.13.1

USP-99

**Polyhydric Alcohol**

U. S. Patent 2,670,336. Harold H. Roth, Bay City, Michigan, assignor to The Dow Chemical Company, Midland, Mich., a corporation of Delaware. 37.3.5

USP-100

**Non-Chalking Titanium Dioxide**

U. S. Patent 2,671,031. Walther R. Whately, Lynchburg, Va., assignor to American Cyanamid Company, New York, N. Y., a corporation of Maine. 22.2.3

USP-101

**Acrylonitrile Solutions**

U. S. Patent 2,671,066. John L. Justice, Chester, Pa., assignor, by mesne assignments, to The Chemstrand Corporation, Decatur, Ala., a corporation of Delaware. 8.1.9

USP-102

**Heat Treatment Process of Hydrocarbon Drying Oils**

U. S. Patent 2,672,425. Anthony H. Gleason, Westfield, and Robert F. Leary, Cranford, N. J., assignors to Standard Oil Development Company, a corporation of Delaware. 35.9.8

USP-103

**Phenolic Composition**

U. S. Patent 2,673,190. Karl Dietz, Kronberg (Taunus), Germany, assignor to Farbwerke Hoechst Aktiengesellschaft vormals Meister Lucius und Bruning, Frankfurt am Main Hochst, Germany, a company of Germany. 13.1.12

USP-104

**Light Stable Vinylidene Chloride Polymers**

U. S. Patent 2,673,191. Robert J. Wolf, Cleveland, Ohio, assignor to The B. F. Goodrich Company, New York, N. Y., a corporation of New York. 18.3.7

USP-105

**Aqueous Polymerization of Vinyl Derivatives**

U. S. Patent 2,673,192. Archie Hill, Painesville, Ohio, assignor to Diamond Alkali Company, Cleveland, Ohio, a corporation of Delaware. 44.2.20

USP-106

**Tank Lining**

U. S. Patent 2,673,817. Arthur E. Burns, Jr., Riverside, Calif., assignor to Hart and Burns, Incorporated, Riverside, Calif., a corporation of Texas. 39.3.36

USP-107

**Liquefaction of Silicone Rubber Gum**

U. S. Patent 2,673,843. Bingham J. Humphrey, Mount Carmel, and Harry H. Wasserman, Hamden, Conn., assignors to The Connecticut Hard Rubber Company, New Haven, Conn., a corporation of Connecticut. 15.1.31

USP-108

**Stain-Filler-Sealer**

U. S. Patent 2,674,538. Orion William Berglund, Dayton, Ohio, assignor to Chadeloid Corporation, Dayton, Ohio, a corporation of Delaware. 39.2.7

USP-109

**Resin Coated Pigment**

U. S. Patent 2,674,587. Thomas Gostage Leek, New York, N. Y., assignor to Edgar Brothers Company, Metuchen, N. J., a corporation of New Jersey. 21.1.18

USP-110

**Ketone-Aldehyde Resins**

U. S. Patent 2,674,591. Theodore White and Jeremy Ralph Barnes Hastings, London, England, assignors to The Forestal Land, Timber and Railways Company Limited, London, England, a British company. 2.1.30

USP-111

**Vinyl Chloride Polymer**

U. S. Patent 2,674,593. Fred E. Condo, El Cerrito, and Jerome R. Vinograd, Berkeley, Calif., assignors to Shell Development Company, Emeryville, Calif., a corporation of Delaware. 18.3.8

USP-112

**Phenolic Resin**

U. S. Patent 2,675,336. John T. Stephan, Seattle, Wash., assignor to Monsanto Chemical Company, St. Louis, Mo., a corporation of Delaware. 13.1.13

USP-113

**Aluminum-Resin Coating**

U. S. Patent 2,675,363. Robert R. Howard, West Collinswood, and Harris M. Wilcox, Gibbsboro, N. J., assignors to R. M. Hollingshead Corporation, Camden, N. J., a corporation of New Jersey. 39.1.38

USP-114

**Mixed Esters of Phenolic Resins**

U. S. Patent 2,676,158. Malcolm M. Renfrew, Minneapolis, Minn., assignor to General Mills, Inc., a corporation of Delaware. 13.1.14

USP-115

**Fire-Retardant Coating**

U. S. Patent 2,676,162. Ralph Marotta, Maiden, Mass., assignor to Monsanto Chemical Company, St. Louis, Mo., a corporation of Delaware. 38.4.3

USP-116

**Wood-Coating**

U. S. Patent 2,676,893. Anton E. Budner, Racine, Wis., assignor to S. C. Johnson & Son, Inc., Racine, Wis. 39.5.10

USP-117

**Copolymerized Product**

U. S. Patent 2,676,933. George E. Serniuk, Roselle, and John D. Garber, Cranford, N. J., assignors to Standard Oil Development Company, a corporation of Delaware. 8.1.10

USP-118

**Wax Composition**

U. S. Patent 2,676,934. John Mann Butler, Dayton, Ohio, assignor to Monsanto Chemical Company, St. Louis, Mo., a corporation of Delaware. 39.1.39

USP-119

**Corrosion-Resistant Coating**

U. S. Patent 2,676,942. Alfred L. Glass, Philadelphia, Pa., assignor to the United States of America as represented by the Secretary of the Navy. 39.3.37

USP-120

**Adhesion Tester**

U. S. Patent 2,677,275. Sigmund S. Dabrowski, Summit, Illinois. 49.1.23

USP-121

**Paint Can**

U. S. Patent 2,677,459. Hyman Ritzenberg, Arlington, Va. 46.6.6

USP-122

**Lead Pigment**

U. S. Patent 2,677,621. William J. Clapson, Joplin, and Earl W. Amthauer, Carl Junction, Mo., assignors to The Eagle-Picher Company, Cincinnati, Ohio, a corporation of Ohio. 22.1.2

USP-123

**Manufacture of Waterproof Materials**

U. S. Patent 2,677,658. Auguste Florentin Bidaud, Serezin-du-Rhone, France, assignor to Societe des Usines Chimiques Rhode-Poulene, Paris, France, a French body corporate. 39.1.40

USP-124

**Glyceride-Fumaric Acid Reaction Products**

U. S. Patent 2,678,934. Oliver J. Grummitt, Cleveland, Ohio, assignor to The Sherwin-Williams Company, Cleveland, Ohio, a corporation of Ohio. 4.1.16

USP-125

**Fire Retardant Coating**

U. S. Patent 2,679,489. George L. Cunningham, Cincinnati, Ohio, assignor to Waterloo Corporation, New York, N. Y., a corporation of New York. 38.4.4

USP-126

**Waterproofing Compositions**

U. S. Patent 2,679,491. Daniel W. Kennedy, Troy, and Frederick G. Weigand, Ballston Lake, N. Y., assignors to General Electric Company, a Corporation of New York. 39.1.41

USP-127

**Siloxane Waterproofing Material**

U. S. Patent 2,679,495. Raymond H. Bunnell, Toledo, Ohio, assignor, by mesne assignments, to Allied Chemical & Dye Corporation, New York, N. Y., a corporation of New York. 39.1.42

USP-128

**Organosilicon Coatings**

U. S. Patent 2,679,496. Raymond H. Bunnell, Toledo, Ohio, assignor, by mesne assignments to Allied Chemical & Dye Corporation, New York, N. Y., a corporation of New York. 15.1.32

USP-129

**Flameproofing Material**

U. S. Patent 2,680,077. Morris L. Nielsen and Russell W. Arnold, Dayton, Ohio, assignors to Monsanto Chemical Company, St. Louis, Mo., a corporation of Delaware. 36.13.2

USP-130

**Vinylidene Chloride Compositions**

U. S. Patent 2,680,106. Carl B. Havens, Hope, Mich., assignor to The Dow Chemical Company, Midland, Mich., a corporation of Delaware. 18.9.1

USP-131

**Flame Resistant Cellulose Acetate Butyrate**

U. S. Patent 2,680,691. Harry S. Olson and Robert C. Danison, Painesville, Ohio, assignors to Diamond Alkali Company, Cleveland, Ohio, a corporation of Delaware. 5.4.2

USP-132

**Tall Oil Rosin Sizes**

U. S. Patent 2,680,694. Justus C. Barthel and Randall Hastings, Stamford, Conn., assignors to American Cyanamid Company, New York, N. Y., a corporation of Maine. 39.2.8

USP-133

**Temporary Protective Coating**

U. S. Patent 2,680,724. Richard D. Oppenheim, Roslyn Heights, N. Y., assignor to Spraylat Corporation, New York, N. Y., a corporation of New York. 39.1.43

USP-134

**Silicate Coating**

U. S. Patent 2,680,725. Charles Di-Battista and Egidio James Di Battista, Cranford, N. J. 40.1.16

USP-135

**Coating with Fluorescent Dye**

U. S. Patent 2,681,317. Harold Grossman, Montclair, N. Y. 39.1.44

USP-136

**Clear and Pigmented Oil-In-Water Resin Emulsions**

U. S.Patent 2,681,322. Laszlo Auer, South Orange, N. J. 19.1.2

USP-137

**Polytetrafluorethylene Coating**

U. S. Patent 2,681,324. Seymore Hochberg, Upper Darby, Pa., assignor to E. I. du Pont de Nemours and Company, Wilmington, Del., a corporation of Delaware. 7.1.2

USP-138

**Water Reducible Fire-Resistant Coating**

U. S. Patent 2,681,326. Conrad J. Christianson, Harvey, Ill., assignor to The Sherwin-Williams Company, Cleveland, Ohio, a corporation of Ohio. 40.4.2

USP-139

**Surface Coatings Composition**

U. S. Patent 2,681,897. Charles Frazier, Brooklyn, N. Y., and Leonard E. Cadwell, Stamford, Conn., assignors to American Cyanamid Company, New York, N. Y., a corporation of Maine. 9.1.4

USP-140

**Modified Polyether**

U. S. Patent 2,682,514. Herbert A. Newey, Lafayette, Calif., assignor the Shell Development Company, Emeryville, Calif., a corporation of Delaware. 6.1.16

USP-141

**Floor and Wall Coating**

U. S. Patent 2,682,517. Annis G. Asaff, Auburndale, Mass., assignor to Callaghan-Hession Corporation, Boston, Mass., a corporation of Massachusetts. 38.1.17

USP-142

**Polyvinyl Acetal Resin**

U. S. Patent 2,682,520. Charles Kilbourne Bump, Hampden, and Frank J. Quinn, Springfield, Mass., assignors to Monsanto Chemical Company, St. Louis, Mo., a corporation of Delaware. 18.6.2

USP-143

**Linear Polymer**

U. S. Patent 2,682,521. Harry W. Coover, Jr., Kingsport, Tenn., assignor to Eastman Kodak Company, Rochester, N. Y., a corporation of New Jersey. 2.1.31

USP-144

**Cross-Linked Polyamides**

U. S. Patent 2,682,524. Donald D. Coffman, West Chester, Pa., assignor to E. I. du Pont de Nemours and Company, Wilmington, Del., a corporation of Delaware. 11.1.6

USP-145

**Cross-Linked Polymers**

U. S. Patent 2,682,525. Harold L. Jackson, Wilmington, Del., assignor to E. I. du Pont de Nemours and Company, Wilmington, Del., a corporation of Delaware. 9.1.5

USP-146

**Interlinking Polymers With Polyactams**

U. S. Patent 2,682,526. Paul J. Flory, Ithaca, N. Y., assignor, by mesne assignments, to The Goodyear Tire & Rubber Company, a corporation of Ohio. 17.1.18

USP-147

**Synthetic Resin**

U. S. Patent 2,683,126. Joseph Nichols, Bronx, N. Y., assignor to Interchemical Corporation, New York, N. Y., a corporation of Ohio. 2.1.32

USP-148

**Acetone Formaldehyde Resin**

U. S. Patent 2,683,133. Mortimer T. Harvey, South Orange, and Peter L. Rosamilia, Bloomfield, N. J., assignors to Harvel Research Corporation, a corporation of New Jersey. 2.1.33

USP-149

U. S. Patent 2,683,134. John B. Davidson and Edward J. Romatowski, Toledo, Ohio, assignors, by mesne assignments, to Allied Chemical & Dye Corporation, New York, N. Y., a corporation of New York. 9.3.2

**Modified Urea Resin**

USP-150

**Synthetic Drying Oil**

U. S. Patent 2,683,162. Anthony H. Gleason, Westfield, N. J., assignor to Standard Oil Development Company, a corporation of Delaware. 35.9.9

USP-151

**Organic Coating**

U. S. Patent 2,683,668. Henry W. Godshalk, Swarthmore, Pa., assignor to E. I. du Pont de Nemours & Company, Wilmington, Del., a corporation of Delaware. 39.1.45

USP-152

**Freeze Stabilized Latex Coatings**

U. S. Patent 2,683,699. Harvey T. Gehring, Chicago, Ill., assignor to The Sherwin-Williams Company, Cleveland, Ohio, a corporation of Ohio. 36.8.5

USP-153

**Freeze-Thaw Latex Paints**

U. S. Patent 2,683,700. Harvey T. Gehring, Chicago, Ill., assignor to The Sherwin-Williams Company, Cleveland, Ohio, a corporation of Ohio. 40.1.17

USP-154

**Ethyl Cellulose Aerosol Lacquer**

U. S. Patent 2,684,915. John S. Tinsley, Wilmington, Del., assignor to Hercules Powder Company, Wilmington, Del., a corporation of Delaware. 39.1.146

USP-155

**Stabilized Wax Emulsion**

U. S. Patent 2,684,948. Sherwood T. Cross, Christiana Hundred, Del., assignor to Atlas Powder Company, Wilmington, Del., a corporation of Delaware. 36.10.5

USP-156

**Melamine Resin**

U. S. Patent 2,684,964. Harry L. Heckel, Jr., Prince George County, Va., assignor to Allied Chemical & Dye Corporation, a corporation of New York. 9.2.3

USP-157

**Stabilized Halogen-Containing Resins**

U. S. Patent 2,699,548. Joseph R. Darby, Richmond Heights, and Leo D. Frederickson, Jr., St. Louis, Mo., assignors to Monsanto Chemical Company, St. Louis, Mo., a corporation of Delaware. 7.1.3

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Alexander, G. B.—2.1.13
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Atherton, D.—49.3.1
Auer, L.—19.1.2
Austin, R. C.—14.1.5
Averill, S. J.—18.1.8
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Bankoff, S. G.—18.4.1
Bannister, D. W.—50.10.1
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Bartels, G. E.—36.5.6
Bartels, G. W., Jr.—9.5.3
Baruch, A. P.—39.1.32
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Bawn, C. E. H.—44.3.1
Bawn, C. E. N.—16.1.21
Bawn, C. V.—44.2.5
Baysal, B.—18.1.11
Beacham, W.—42.2.15
Beakes, H. L.—46.4.1
Bean, C. T.—17.1.6
Beasley, J. K.—12.2.6
Beatty, G. H.—50.4.3
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Bede, J. A.—42.2.16
Bender, H. L.—13.1.2
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# MEMORANDA

# SUPPLIERS' TRADE NAME INDEX

## A

*Abay*—Mills & Mixing machinery. **Paul O. Abbe Inc.**
*Abbe*—Mills & mixing machinery. **Paul O. Abbe Inc.**
*Abitol*—Technical hydroabietyl alcohol. **Hercules Powder Company**
*AC*—Polyethylene. **Somet-Solvay Petrochemical Division**
*Acintene*—Pinenes and turpentine. **Arizona Chemical Company**
*Acintol*—Tall Oil. **Arizona Chemical Company**
*Acme*—Shellac Varnish. **Acme Shellac Products Co.**
*Aconew Extra*—Refined tall oil fatty acids. **Newport Industries, Inc.**
*Aconon*—Refined tall oil. **Newport Industries, Inc.**
*Acosix*—Refined tall oil. **Newport Industries Inc.**
*Acrawax*—Synthetic waxes. **Glyco Products Co., Inc.**
*Acryloid*—Acrylic ester resins. **Rohm & Haas Company**
*Acrylonitrile*—Monomers. **Carbon and Carbon Chemicals Company**
*Activ-8*—Drier-stabilizer. **R. T. Vanderbilt Co.**
*Adher-O-Flex*—Esterified Shellac. **Acme Shellac Products Co.**
*Adipol*—Plasticizer. **Ohio—Apex Division**
*ADM Adols*—Fatty Alcohols. **Archer Daniels Midland Company**
*ADM Ester Gum*—Complete line of Ester Gums **Archer Daniels Midland Company**
*ADM Natural Resins*—Congo, Damar, East India, Kauri Gum, Manila Gum. **Archer Daniels Midland Company**
*ADM Processed Congo*—Fused & Esterified Congo Gum. **Archer Daniels Midland Company**
*ADM Unadols*—Fatty Alcohols. **Archer Daniels Midland Company**
*A D P*—Carbon Black dispersions. **Acheson Dispersed Pigments Co.**
*Advacides*—Fungicides. **Advance Solvents & Chemical Corporation**
*Advamix*—wetting agent. **Advance Solvents & Chemical Corporation**
*Advaresins*—Zinc hardened, tall oil products **Advance Solvents & Chemical Corporation**
*Advasol*—Driers. **Advance Solvents & Chemical Corporation**
*Advastabs*—vinyl stabilizers. **Advance Solvents & Chemical Corporation**
*Advawets*—emulsifiers. **Advance Solvents & Chemical Corporation**
*Aero*—Maleic and Phthalic Anhydrides; Various grades of Aluminum, Zinc, and Calcium Metallic Soaps. **American Cyanamid Company**
*Aerosol*—Surface Active Agents. **American Cyanamid Company**
*Air-Matic*—Small parts washer. **The Protecto-seal Co.**
*Alamask*—Paint deodorant. **Rhodia, Inc.**
*Alathon*—Polyethylene resin. **E. I. du Pont de Nemours & Co.**
*Albacar*—Precipitated calcium carbonate. **C. K. Williams & Co.**
*Albalith*—Lithopone. **New Jersey Zinc Co.**
*Albone*—Hydrogen peroxide. **E. I. du Pont de Nemours & Co.**
*Alcoa*—Aluminum Powders and Pastes. **Aluminum Company of America**
*Albron*—Aluminum Powders and Pastes. **Aluminum Company of America**
*Algel*—Gelling agent. **Raybo Chemical Company**
*Alkaterge—C*—Surface active agent. **Commercial Solvents Corporation**
*Alkyum*—Alkyd Resin. **Adco Chemical Company**
*Alodine*—Protective coating chemicals for aluminum and aluminum alloys. **American Chemical Paint Company**
*Alrosols*—Surface Active agent. **Geigy Industrial Chemicals**
*Alsibrons*—Water ground Mica. **Franklin Mineral Products Company**
*Alsuberlac*—Modified alkyds. **Rohm & Haas Company**
*Alsuberol*—Varnish and lacquer resins. **Rohm & Haas Company**
*Amine O*—Surface active agent. **Geigy Industrial Chemicals**
*Amsco-Solv*—A group of intermediate aromatic petroleum solvents in varying boiling ranges. **American Mineral Spirits Company**
*Antifoam A*—Silicone defoamer. **Dow Corning Corp.**
*Antioxidant B*—Antiskinning agent and antioxidant. **National Aniline Division**
*Antioxidant D*—Antiskinning agent and antioxidant. **National Aniline Division**
*AntiSag*—Anti-sagging, anti-settling, wetting and dispersing agent. **Raybo Chemical Company**
*AntiSilk*—anti-silking, anti-floating agent. **Raybo Chemical Company**
*Antistat*—anti-static agent. **Raybo Chemical Company**
*Apco*—Aliphatic hydrocarbon thinner. **Anderson-Prichard Oil Corporation**
*Apcothinner*—Aliphatic petroleum thinner. **Anderson-Prichard Oil Corporation**
*Aquasperse 30*—Casein vehicle for emulsion paints. **American Resinous Chemicals Corporation**
*AR*—Polyester resins. **General Electric**
*Araldite*—Epoxy resins. **Ciba Company Inc.**
*A-Resin*—Heat convertible unsaturated aliphatic pure hydrocarbon polymer. **Enjay Company, Inc.**
*Arilemp*—Epoxy Casting Resins. **Aries Laboratories, Inc.**
*Arochem*—Modified Phenolic Resins, modified maleic resins, specialty resins. **Archer Daniels Midland Company**
*Aroclor*—Chlorinated biphenyl resins. **Monsanto Chemical Co.**
*Arofene*—Pure Phenolic Resins. **Archer Daniels Midland Company**
*Aroflat*—Alkyds & Specialties for Flat Finishes. **Archer Daniels Midland Company**
*Arooslocrat*—Potato Starch. **Morningstar, Nicol, Inc.**
*Aroplaz*—Alkyd and Allied Resins. **Archer Daniels Midland Company**
*Aropol*—Copolymer Modified Alkyds, Polyester Resins. **Archer Daniels Midland Company**
*Asbestol*—Calcium carbonate extender pigments. **Carbola Chemical Co.**
*ASP*—Extender pigments, aluminum silicate. **Minerals & Chemicals Corp. of America**
*Attaclay*—Finely powdered fullers earth. **Minerals & Chemicals Corp. of America**
*Attasol*—Colloidal fullers earth. **Minerals & Chemicals Corp. of America**
*Attasorb*—Fullers Earth. **Minerals & Chemicals Corp. of America**
*Atlac*—Polyester Alkyd Resins. **Atlas Powder Company**
*Auto-Klean*—Allmetal edge type filter. **The Cuno Engineering Corp.**
*Azo*—Zinc oxide pigments; lead-free and leaded **American Zinc Sales Co.**

## B

*BCU*—Urea resins. **Bakelite Company**
*Bear*—Lampblack. **Monsanto Chemical Company**
*Beckacite*—Modified Phenolic resins. **Reichhold Chemicals, Inc.**
*Beckamine*—Urea-formaldehyde resins. **Reichhold Chemicals, Inc.**
*Beckolin*—Synthetic drying oils. **Reichhold Chemicals Inc.,**
*Beckobol*—Modified phenolic resins. **Riechhold Chemicals, Inc.**
*Beckosol*—Pure and modified alkyd resins. **Reichhold Chemicals, Inc.**
*Beetle*—Alkylated Urea-Formaldehyde Resins **American Cyanamid Company**
*Benthal*—Polyhydric alcohol. **Monsanto Chemical Co.**
*Bentone*—Gelling Agents. **National Lead Company**
*Benzoflex*—Chemical Plasticizers. **Tennessee Products & Chemical Corporation**
*Big-M-Gel*—Long oil liquid gel. **Adco Chemical Company**
*Black Pearls*—Carbon Black pigments. **Godfrey L. Cabot, Inc.**
*Blancol*—Anionic dispersant. **Antara Chemicals**
*B. M. G.*—Long oil liquid gel. **Adco Chemical Company**
*Borotherm*-Highly soluble borate composition for fire resistant water-base paints. **American Potash & Chemical Corp.**
*BR Castor Oil*—Bleached, refined, raw castor oil. **Pacific Vegetable Oil Corp.**
*Brij*—Emulsifiers; polyoxyethylene lauryl ethers. **Atlas Powder Co.**
*Bronoco*—Aliphatic and aromatic petroleum solvents. **The R. J. Brown Company.**
*BRS*—Polyester resins. **Bakelite Company**
*Buckeye Pro-Cote*—Protein thickener-stabilizer. **The Buckeye Cotton Oil Company**
*Buckeye Protein*—Protein thickener-stabilizer. **The Buckeye Cotton Oil Company**
*Bufen 30*—Preservative. **Buckman Laboratories, Inc.**
*Bufenoleate 30*—Preservative. **Buckman Laboratories, Inc.**
*Burtonite*—Guar Seed Gum. **The Burtonite Co.**
*Butaprene*—Styrene-Butadiene Copolymer Emulsion for paint. **Firestone Plastics Company**
*Butrol*—Preservative. **Buckman Laboratories, Inc.**
*Butvar*—Polyvinyl butyral resin. **Monsanto Chemical Co.**

## C

*C-8*—Epoxy resins. **Bakelite Company**
*Cabflex*—Chemical plasticizers. **Godfrey L. Cabot, Inc.**
*Cabotite*—Nonmetallic mineral extender pigment **Godfrey L. Cabot, Inc.**
*Cab-o-sil*—Silica pigment used in paints and varnishes. **Godfrey L. Cabot, Inc.**
*Cadmolith*—Cadmium red and yellow lithipones. **The Glidden Company**
*Calcicoater Oil*—Bodied Vegetable oil. **Pacific Vegetable Oil Corp.**
*Caltrol*—Viscosity controller. **Brown-Allen Chemicals, Inc.**
*Carbitol*—Solvent. **Carbide and Carbon Chemicals Company**
*Carbolac*—Carbon black pigments. **Godfrey L. Cabot, Inc.**
*Carbopol*—Water sensitive gum, paint thickener. **B. F. Goodrich Chemical Company**
*Carbose*—Sodium Carboxymethylcellulose. **Wyandotte Chemicals Corp.**
*Cargoils*—Fish oil based oils for barn paints. **Cargill, Inc.**
*Cargillon*—Polyester resins. **Cargill, Inc.**
*Casco*—Urea-formaldehyde Resins. **The Borden Company**
*C-D-M*—Centrifugally Cast Dual Metal Rolls. **J. M. Lehmann Co., Inc.**
*Celite*—Extender pigment, diatomaceous silica. **Johns-Manville**
*Cellolyn*—Abitol-derived alkyds and modified pentaerythritol esters of rosin. **Hercules Powder Company**
*Cellosize*—Hydroxyethyl Cellulose. **Carbide and Carbon Chemicals Division**
*Cellosolve*—Solvent. **Carbide and Carbon Chemicals Company**
*Charlotte*—Colloid Mill. **Chemicolloid Laboratories Inc.**
*Chemstor*—Glass lined storage tanks. **The Pfaudler Co.**
*Cherokee*—Kaolin Clay. **R. T. Vanderbilt Co.**
*Chlorowax 40*—Plasticizer; Liquid chlorinated paraffin. **Diamond Alkali Company**
*Chlorowax 70*—Resinous chlorinated paraffin. **Diamond Alkali Company**
*Chlorowax*—resinous chlorinated paraffin. **Diamond Alkali Company**
*CMC*—Sodium carboxymethylcellulose. **Hercules Powder Co.**
*C-Oil*—hydrocarbon drying oil. **Enjay Company, Inc.**
*Cold-Pro*—Bleached Shellac. **Acme Shellac Products Co.**
*Concord Maroon*—Deep BON Maroon. **Standard Ultramarine & Color Co.**
*Continental*—Kaolin Clay. **R. T. Vanderbilt Co.**
*Continental*—Carbon Blacks. **Witco-Continental**
*Continex*—Furnace carbon black. **Witco-Continental**
*Coors*—High density grinding media. **LZP Industrial Ceramics**
*Cosol*—High-flash naphtha. **Neville Chemical Company**
*Covertex*—Vehicles for emulsion paints and Latex Modifiers. **McCloskey Varnish Co.**
*Cunilate*—Fungicides. **Scientific Oil Compounding Company, Inc.**

*Cunimene*—Fungicides. **Scientific Oil Compounding Company, Inc.**
*Cyclodex*—An emulsifiable cobalt catalyst. **Nuodex Products Co., Inc.**
*Cykel*—Dicyclopentadiene treated vegetable oil. **Spencer Kellogg & Sons Inc.**
*Cykelin*—Dicyclopentadiene treated oil linseed. **Spencer Kellogg & Sons Inc.**
*Cykelsoy*—Dicyclopentadiene treated soybean oil **Spencer Kellogg & Sons Inc.**
*Crypton ZS*—Zinc Sulfide. **New Jersey Zinc Co.**
*CTLA*—Heat-reactive, aromatic-type olefinic hydrocarbon polymer. **Enjay Company Inc.**
*Cumar*—Paracoumarone-indene resins. **Barrett Division**
*Cycolac*—Styrene copolymer resin. **Marbon Corporation.**
*Cycopol*—Copolymer Resins. **American Cyanamid Company**

## D

*Dag*—Colloidal graphite dispersions. **Acheson Colloids Company**
*Darex Copolymer*—Styrene-Butadiene Copolymer. **Dewey & Almy Chemical Co.**
*Darex DIOP*—Chemical Plasticizers. **Dewey & Almy**
*Darex Everflex*—Polyvinyl Acetate emulsion. **Dewey & Almy Chemical Co.**
*Darvan*—Dispersing Agents. **R. T. Vanderbilt Co.**
*Davenite P-12—325* Mesh Water ground mica. **Hayden Mica Company**
*Defoamer ED*—Anti-Foam Agent. **El Dorado Oil Works**
*Deodorized Apco*—Deodorized aliphatic hydrocarbon thinner. **Anderson-Prichard Oil Corporation**
*Deo Oil*—Deodorized fish oil. **Pacific Vegetable Oil Corp.**
*Deoxidine*—Metal cleaners and rust removers. **American Chemical Paint Company**
*Detrex 79*—Cleaner & phosphate treatment for steel. **Detrex Corporation**
*D.G.*—Magnesium Silicate. **Tamms Industries, Inc.**
*Dicalite*—Diatomaceous Silica extender pigment. **Great Lakes Carbon Corporation**
*Dicom*—Dipentene. **Newport Industries, Inc.**
*Dinopol*—Plasticizer. **Ohio—Apex Division**
*Dipentek*—Dipentaerythritol technical. **Heyden Chemical Corporation**
*Dipentene No. 122*—Solvent—51% dipentene with other terpene hydrocarbons. **Hercules Powder Co.**
*Disperse*—aqueous phase dispersant. **Raybo Chemical Company**
*Disperso*—Wettable Metallic stearates. **Witco Chemical Company**
*Dixie Perfecto, 5*—Carbon Black. **United Carbon Co., Inc.**
*Dixie Reds*—Toluidine and Para Substitutes. **Standard Ultramarine & Color Co.**
*DMT*—Dinethyl terephthalate. **Hercules Powder Company**
*Doubl*—Limed wood rosin. **Newport Industries, Inc.**
*Dowicides*—Industrial germicide & fungicides. **Dow Chemical Company**
*Dow Latex*—Emulsion of either vinyl chloride—vinylidene chloride copolymer, styrene—butadiene copolymer, or polyvinylidene chloride. **The Dow Chemical Company**
*Dresinate*—Surface active sodium and potassium. salts of rosins and tall oil. **Hercules Powder Company**
*Dri-Film*—Silicone water-repellents. **General Electric**
*Drisoy*—Treated soybean oil. **Spencer Kellogg & Sons Inc.**
*Dryolene*—Aliphatic petroleum thinner (VM&P). **Anderson-Prichard Oil Corporation**
*Duol*—Resinated Lithol Rubine pigment. **E. I. du Pont de Nemours & Co.**
*Duraplex*—Phthalic alkyd resins. **Rohm & Haas Company**
*Duratone Reds*—Toluidine and Para Substitutes. **Standard Ultra marine& Color Co.**
*Durez*—Phenol-formaldehyde resins. **Durez Plastics & Chemicals, Inc.**
*Duroxon*—Soft Waxes. **Dura Commodities Corporation**
*Dutch Boy*—Pigments—antimony oxide, calcium carbonate, barytes, white lead, red lead, litharge Linseed oils
Chemical Plasticizers. **National Lead Company**
*Dymerex*—Dimerized wood rosin. **Hercules Powder Co.**
*Dyphos*—Stabilizers for vinyls. **National Lead Company**

## E

*Eagle-Picher*—Lead and Zinc Pigments. **The Eagle-Picher Company**
*EGD*—Acrylic Monomer. **American Monomer Corporation**
*EHEC*—Ethylated hydroxethyl cellulose. **Hercules Powder Co.**
*Eldo*—Coconut Fatty Acid. **ElDorado Oil Works**
*Elf*—Carbon black pigments. **Godfrey L. Cabot, Inc.**
*Elftex*—Carbon black pigments. **Godfrey L. Cabot, Inc.**
*Elvacet*—Polyvinyl acetate emulsion. **E. I. du Pont de Nemours & Co.**
*Elvadex*—Vinyl acetate copolymer. **E. I. du Pont de Nemours & Co.**
*Elvanol*—Polyvinyl alcohol resin. **E. I. du Pont de Nemours & Co.**
*Emcol H-50A*—Hydrocarbon Solvent Emulsifier. **The Emulsol Corporation**
*Emerox*—Dibasic acids. **Emery Industries, Inc.**
*Emersol*—Fatty acids made by selective solvent separation. **Emery Industries, Inc.**
*Emfac*—Monobasic acids. **Emery Industries, Inc.**
*Empol*—Polymerized fatty acids. **Emery Industries, Inc.**
*Emulphor*—Nonionic surfectant. **Antara Chemicals**
*Epi-rez*—Pure epichlorohydrin bisphenol resins. **Jones-Dabney Co.**
*Epi-tex*—Oil modified epichlorohydrin bisphenol resins. **Jones-Dabney Co.**
*Epi-Var*—Oil modified epichlorohydrin bisphenol resins. **Jones-Dabney Co.**
*Epocast*—Epoxy resins. **Furane Plastics**
*Epon resins*—Epoxy resins. **Shell Chemical Corp.**
*ERCO Brown*—Concentrated brown iron oxides. **Reichard-Coulston, Inc.**
*Espesol*—Aromatic petroleum solvents. **Eastern States Chemical Corp.**
*Esskol*—refined linseed oil. **Spencer Kellogg & Sons Inc.**
*Esso*—Aliphatic petroleum solvents. **Esso Standard Oil Company**
*Ester Gum 8D and 8L*—Glycerol esters of pale wood rosin. **Hercules Powder Co.**
*Ethocel*—Ethyl Cellulose resins. **The Dow Chemical Company**
*Ethofats*—Surface active agents. **Armour Chemical Division**
*Ethomeens*—Surface active agents. **Armour Chemical Division**
*Ethomids*—Surface active agents. **Armour Chemical Division**
*EXBC*—Polyvinyl Ethyl ether polymer. **Bakelite Company**
*EXBM*—Polyvinyl ethyl ether polymer. **Bakelite Company**
*Excelsior*—Carbon Black pigment. **Binney & Smith Inc.**
*Exkins*—Volatile anti-oxidant. **Nuodex Products Co., Inc.**
*Exon*—Vinyl Resins. **Firestone Plastics Company**

## F

*Fade-Ometer*—Sunfastness Testing Machine. **Atlas Electric Devices Co.**
*FAFL*—Flat Alkyd Vehicle. **Farnow Varnish Works**
*Falk Soybean Oils*—Soybean oils, (raw, bodied, blown, kettled and specialty). **Cargill, Inc.**
*Falkidine*—Hard drying fish oils. **Cargill, Inc.**
*Falkosoy*—Maleinized soybean oils. **Cargill, Inc.**
*Falkomast*—Fish and soybean oils specially processed for coulking compounds. **Cargill, Inc.**
*Falkore*—Esterified tall oils.—**Cargill, Inc.**
*Falkote*—Maleic ester gums. **Cargill, Inc.**
*Falkovar*—Fish oils, (raw, bodied, blown, kettled and specialty). **Cargill, Inc.**
*Falkowood*—Maleinized linseed oils and fish oils. **Cargill, Inc.**
*Falkolin*—Linseed oils. (raw, bodied, blown, kettled and specialty). **Cargill, Inc.**
*Falkyd*—Oil modified alkyd resins. **Cargill, Inc.**
*Fatchemco-O*—Emulsifier. **Universal Chemicals Corporation**
*FCD*—Alkyd, phenolic, natural resins. **France, Campbell & Darling, Inc.**
*Fine*—Organic dry colors. **Fine Colors Company**
*Flexcl*—Plasticizers. **Carbide and Carbon Chemicals Company**
*Flexowax C*—Synthetic wax; anti-mar agent for enamels. **Glyco Products Co., Inc.**
*Flo Inducer*—levelling agent. **Raybo Chemical Company**
*Florence*—French Process Zinc Oxide. **New Jersey Zinc Co.**
*Flow-Master*—Homogenizer. **Marco Company, Inc.**
*Fluorothene*—Polymonochlorotrifluoroethylene polymer. **Bakelite Company**
*Fo-Glo*—Rosin gloss oil. **Newport Industries, Inc.**
*F-O-M*—Float-O-Matic control of rolls. **J. M. Lehmann Co., Inc.**
*Formvar*—Polyvinyl formal resin. **Monsanto Chemical Co.**
*Fosbond*—phosphate coating and rust-proofing compound. **Pennsylvania Salt Manufacturing Co.**
*Fosfo*—Limed wood rosin. **Newport Industries, Inc.**
*Foster*—Rotary Pumps. **Foster Pump Works, Inc.**
*Fotocol*—Proprietary Solvent. **Commercial Solvents Corporation**
*FR-28*—Sodium Borate, fire retardant. **Pacific Coast Borax Co.**

## G

*Gelva*—Polyvinyl acetate resins. **Shawinigan Products Corporation**
*Gelva Emulsion*—Polyvinyl acetate emulsion **Shawinigan Products Corporation**
*Gen-Flo*—Natural rubber latex. **The General Tire & Rubber Co.**
*Genesol #2,#6*—Terpene solvent. **Newport Industries, Inc.**
*Geon Latex*—Polyvinyl chloride emulsions. **B. F. Goodrich Chemical Company**
*Geon Resin*—Polyvinyl chloride resins. **B. F. Goodrich Chemical Company**
*GGP Aluminum Extra Brilliant*—Flake Aluminum Powder. **U. S. Bronze Powder Works, Inc.**
*Glaurin*—Grinding aid and dispersing agent **Glyco Products Co., Inc.**
*Glyptal*—Alkyd resins. **General Electric**
*G.N.S. No#5*—Pine Oil. **Newport Industries Inc.**
*Gold Bond "R" Silica*—Amorphous Silica. **Tamms Industries, Inc.**
*Grandodraw*—Zinc-phosphate coating chemical for cold-forming. **American Chemical Paint Company**
*Granodine*—Zinc-phosphate coating chemicals for bonding paint to steel. **American Chemical Paint Company**
*Grip-Tight*—Labeling Paste. **Paisley Products Inc.**
*Groco*—Fatty acids. **A. Gross & Company**
*Gulf*—Aliphatic petroleum solvents. **Gulf Oil Corporation**
*Guyandot Red Toners*—Toluidine Substitutes. **Standard Ultramarine & Color Co.**

## H

*Half-second butyrate*—cellulose acetate butyrate resin. **Eastman Chemical Products, Inc.**
*Halowax*—Chlorinated naphthalene waxes. **Bakelite Company**
*Harshaw-V*—Vinyl Stabilizers. **The Harshaw Chemical Co.**
*HB-20,40*—Alkyl-aryl type plasticizers. **Monsanto Chemical Co.**
*Heliogen*—Phthalocyanine blue and green pigments. **General Dyestuff Corp.**
*Helix*—Limed wood rosin. **Newport Industries, Inc.**
*Hercoflex*—Chemical plasticizers. **Hercules Powder Company**
*Hercolyn*—Hydrogenated methyl ester of rosin. **Hercules Powder Co.**
*Hexogen*—Driers. **Advance Solvents & Chemical Corporation.**
*Hifos*—Limed wood rosin. **Newport Industries, Inc.**
*HiSolv Solvents*—Petroleum Aromatic solvents. **Pennsylvania Industrial Chemical Corporation**
*Horse Head*—Zinc pigments. **New Jersey Zinc Co.**
*HR Cobalt 254*—A cobalt "feeder" drier. **Nuodex Products Co., Inc.**
*HTS*—Basic Carbonate White Lead. **National Lead Company**
*Hyfac*—Hydrogenated fatty acid. **Emery Industries, Inc.**
*Hypalon*—Methacrylic ester polymers and chlorosulfonated polyethylene elastomer. **E. I. du Pont de Nemours & Co.**
*Hyros*—Heat-treated wood Rosin. **Newport Industries, Inc.**
*Hy-Speed*—Agitators & Mixers. **Alsop Engineering Corporation**

## I

*Iceberg*—Aluminum Silicate Pigments. **Burgess Pigment Company**
*Igepal*—Emulsifiers. **Antara Chemicals**
*Indopol*—Liquid polybutenes. **Indoil Chemical Company**
*Indulin-70-GR-S*—Coprecipitate of lignin and a butadiene-styrene copolymer. **West Virginia Pulp and Paper Company**
*Irrathene*—Irradiated polyethylene. **General Electric**
*IROX Red*—calcined synthetic yellow oxide. **Reichard-Coulston, Inc.**
*IROX Yellow*—Precipitated pure yellow oxide. **Reichard-Coulston, Inc.**
*Isco Amorphous Silica*—Extender pigment; Silica. **Innis, Speiden & Co. Inc.**
*Isofoam*—Polyisocyanate foaming resin. **Isocyanate Products, Inc.**

## J

*Jaysol*—Isopropyl alcohol. **Enjay Company Inc.**
*Jet*—Mixers. **Hermas Machinery Co., Inc**

## K

*Kadox*—Finest particle size Zinc Oxides. **New Jersey Zinc Co.**
*Kady Mills*—Dispersion Milling equipment. **Kinetic Dispersion Corporation**
*Kaymol*—Surface active agent, emulsifier, and foaming agent. **Kraft Chemical Company**
*KCC*—Talc type extender. **Kraft Chemical Company**
*Kel-F*—Trifluorochloroethylene polymer. **The M. W. Kellogg Company**
*Kellin*—Refined linseed oil. **Spencer Kellogg & Sons Inc.**

*Kirol*—Styrenated linseed and soybean oils. **Spencer Kellogg & Sons Inc.**
*K-Vi-Tol*—Processed linseed oil. **Spencer Kellogg & Sons Inc.**
*K-X-L*—Treated Linseed oil. **Spencer Kellogg & Sons Inc.**
*Kunite*—Extender pigment; Diatomaceous Earth. **Innis, Speiden & Co. ,Inc.**
*Kopol*—Congo copal resins. **Reichhold Chemicals, Inc.**
*Kresin*—Condensation product of p-tertiary butyl phenol with acetylene. **General Dyestuff Corporation**
*Krp*—Soda-treated wood Rosin. **Newport Industries, Inc.**
*Kosmolak*—Carbon Black. **United Carbon Co., Inc.**
*Kosmos F-4, BB, 1*—Carbon Black. **United Carbon Co., Inc.**
*Kreelon*—Emulsifying wetting and penetrating agent (Anionic). **Wyandotte Chemicals Corp.**
*Kroma Reds*—Pure precipitated red iron oxides. **C. K. Williams & Co.**
*Kronitex*—Chemical Plasticizers. **Ohio—Apex Division**
*Kronisol*—Chemical Plasticizers. **Ohio—Apex Division**
*Krumbhaar*—Phenolic resins. **Krumbhaar Chemicals Inc.**
*KTPL*—Polystyrene resins. **Koppers Company, Inc.**

## L

*Lactol Spirits*—An aliphatic naphtha in the toluol evaporation range. **American Mineral Spirits Company**
*Laminac*—Unsaturated Polyester Resins. **American Cyanamid Company**
*Landora*—Soda-treated wood Rosin. **Newport Industries, Inc.**
*Lauxein*—Casein and soybean adhesives. **Monsanto Chemical Co.**
*Lauxite*—Urea, phenolic, melamine, and resorcinol resins. **Monsanto Chemical Co.**
*"L" China Clay*—China Clay. **Tamms Industries, Inc.**
*L. C. Lin*—Low Cost bodied linseed oil. **Brown-Allen Chemicals, Inc.**
*Lehigh*—Leaded Zinc Oxide. **New Jersey Zinc Co.**
*Lemac*—Polyvinyl Acetate Beads. **American Monomer Corporation**
*Lemol*—Polyvinyl Alcohol resins. **American Monomer Corporation**
*Lewisol*—Maleic alkyd-modified rosin esters. **Hercules Powder Co.**
*Lightnin*—Mixers. **Mixing Equipment Co., Inc.**
*Lignocol*—Anti-skinning agent and anti-oxidant. **Heyden Chemical Corporation**
*Lithoform*—Zinc-phosphate coating chemicals for bonding paint to zinc. **American Chemical Paint Company**
*Lo-Odor*—Octasol driers. **The Harshaw Chemical Co.**
*Lorite*—Diatomaceous Material. **National Lead Company**
*Lorol*—Fatty Alcohols. **E. I. du Pont de Nemours & Company**
*LP-2*—Polysulfide hydrocarbon resins. **Thiokol Corporation**
*Lucite*—Methyl Methacrylate resin. **E. I. du Pont de Nemours & Co.**
*Lumigraphic colors*—Special organic colors fluorescing in daylight or under ultraviolet light. **Imperial Paper and Color Corporation**
*Lustrex*—Polystyrene resins. **Monsanto Chemical Co.**
*Lustrex Latex*—Polystyrene emulsion. **Monsanto Chemical Co.**

## M

*Magnaflake*—Metal Powders and Pastes. **Magna Manufacturing Co., Inc.**
*Makanol*—Unsaturated fatty alcohols. **The Stepan Chemical Company**
*Mammopol*—Modified fish Oil. **Pacific Vegetable Oil Corp.**
*Mapico*—Iron Oxide pigments. **Columbian Carbon Company**
*Marbon 9200*—Styrene copolymer resin. **Marbon Corporation**
*Marco*—Unsaturated Polyester Resins. **Celanese Corporation of America**
*Marcolhix*—Unsaturated Polyester Resin. **Celanese Corporation of America**
*MarHard*—mar proofing agent. **Raybo Chemical Company**
*Marlin Maroon*—Yellowish BON Maroon. **Standard Ultramarine & Color Co.**
*Maroc 6*—Limed wood rosin. **Newport Industries, Inc.**
*Maskit #2*—Paint deodorant. **Aromatic Products, Incorporated**
*MC*—Catalyst for Unsaturated Polyster resins. **Celanese Corporation of America**
*MD*—Aluminum powders & pastes. **Metals Disintegrating Company Inc.**
*MDA*—Methylene Disalicylic Acid. **Heyden Chemical Corporation**
*Melmac*—Alkylated Melamine-Formaldehyde Resins. **American Cyanamid Company**
*Mersolite*—Fungicides Phenyl Mercury Salts. **Innis, Speiden & Co., Inc.**
*Mert ZT*—Fungicide. **Caroline Aniline & Extract Co.**
*Methac*—Ester Solvent. **American Monomer Corporation**
*Methocel*—Methyl Cellulose. **The Dow Chemical Company**
*Methylon*—Chemical-resistant coating intermediates. **General Electric**
*Metrolin*—Enamel and paint vehicle. **Brown-Allen Chemicals, Inc.**
*Metso 99*—Surface active agents. **Philadelphia Quartz Company**
*Micro-Klean*—Micronic disposable filter cartridge. **The Cuno Engineering Corp.**
*Micro-Mica*—Finely ground Micronized Mica. **The English Mica Company**
*Micro Velva*—Calcium carbonate extender pigment **Carbola Chemical Co.**
*Mikro*—Milling machinery. **Pulverizing Machinery Company**
*Mill*—Limed wood rosin. **Newport Industries, Inc.**
*Milmer*—Fungicides. **Monsanto Chemical Company**
*Mintrol Spirits*—A new mineral spirits with a very mild odor. **American Mineral Spirits Company**
*Mirasol*—Alkyd Resins. **C. J. Osborn Company**
*Modicol VD*—Synthetic Thickener for Latex Paints. **Nopco Chemical Co.**
*Mogul*—Carbon black pigments. **Godfrey L. Cabot, Inc.**
*Molacco*—Carbon Black Pigment. **Binney & Smith Inc.**
*Molora Marcon*—Light BON Maroon. **Standard Ultramarine & Color Co.**
*Monarch*—Carbon black pigments. **Godfrey L. Cabot, Inc.**
*Monarchrome Greens*—Pigments; co-precipitated phthalocyanine blue and chrome yellow. **Imperial Paper and Color Corporation**
*Monastral*—Copper phthalocyanine blue and green. **E. I. du Pont de Nemours & Co.**
*Monopentek*—Monopenltaerythritol. **Heyden Chemical Corporation.**
*Monoplex*—Monomeric ester plasticizers. **Rohm & Haas Company**
*Monosulph*—Emulsifier for water-based paints. **Nopco Chemical Co.**
*Morningstar*—Starches and Dextrines. **Morningstar, Nicol, Inc.**
*MPL*—Acrylic Monomer. **American Monomer Corporation**
*M R*—Unsaturated Polyester Resins. **Celanese Corporation of America**
*MS2*—Alicyclic ketone resin. **Howards & Sons LTD.**
*Multicel*—Diatomaceous Earth. **Tamms Industries, Inc.**
*Multifex*—Calcium Carbonate Extender Pigments. **Diamond Alkali Company**
*Munn*—Soda-treated wood Rosin. **Newport Industries, Inc.**

## N

*Naccolene Concentrate*—Detergent. **National Aniline Division**
*Nacconols*—Detergents. **National Aniline Division**
*National ASA*—Antiskinning agent and anti-oxidant. **National Aniline Division**
*Natural-Shape Media*—High density grinding media. **LZP Industrial Ceramics**
*Nebony*—Thermoplastic hydrocarbon resins. **Neville Chemical Company**
*Neo-fats*—Fatty Acids. **Armour Chemical Division**
*Neosol*—A proprietary solvent. **Shell Chemical Corporation**
*Neo Spectra*—Carbon Black pigment. **Binney & Smith Inc.**
*Nestaco*—Potato Starch. **Morningstar, Nicol, Inc.**
*Netlco*—Agitating equipment. **New England Tank & Tower Company**
*Nevillac*—Phenol-modified coumarone and alkylated phenols. **Neville Chemical Company**
*Nevindene*—Coumarone-indene resins. **Neville Chemical Company**
*Nevinol*—Plasticizing and solvent oils. **Neville Chemical Company**
*Nevsolv*—Aromatic petroleum solvents. **Neville Chemical Company**
*Newtrex*—Special wood rosin. **Newport Industries, Inc.**
*N-Glo-5&5 Y*—Rosin gloss oil. **Newport Industries, Inc.**
*Non-fer-Al*—Calcium Carbonate Extender Pigments. **Diamond Alkali Company**
*Nonic*—Surface active agents. **Sharples Chemicals Inc.**
*Nonisols*—Surface active agent. **Geigy Industrial Chemicals**
*Nopco*—Anti-foam agents, freeze-thaw stabilizers, wetting agents. **Nopco Chemical Company**
*Nopco 1572-R*—Polyvinyl acetate emulsion. **Nopco Chemical Co.**
*Nopcote*—Polyamide resins. **Nopco Chemical Co.**
*Nora*—Soda-treated wood Rosin. **Newport Industries, Inc.**
*Norlin*—Catalytically polymerized linseed and Soybean oils. **Cargill, Inc.**
*Normasal*—Stabilizers for vinyls. **National Lead Company**
*Norvan*—Polyvinyl Acetate Emulsions. **R. T. Vanderbilt Co.**
*NPA*—Semi-Alkyd Vehicles. **Farnow Corp.**
*Nuact Paste*—Lead "feeder" drier. **Nuodex Products Co., Inc.**
*Nuade*—Grinding aid. **Nuodex Products Co., Inc.**
*Nuba*—Coumarone-indene resins. **Neville Chemical Company**
*Nulix-15*—Limed polymerized wood rosin. **Newport Industries, Inc.**
*Nuodex*—Fungicides and driers. **Nuodex Products Co., Inc.**
*Nuogel A. O.*—Thickening agent. **Nuodex Products Co., Inc.**
*Nuolates*—Tallate driers. **Nuodex Products Co., Inc.**
*Nuomix*—Surface active agent. **Nuodex Products Co., Inc.**
*Nuosperse 657*—A combination of surface active agents. **Nuodex Products Co., Inc.**
*Nurez*—Polymerized wood rosin. **Newport Industries, Inc.**
*Nyco Super*—Phthalocyanine blue and green pigments. **New York Color & Chemical Co.**
*Nycolime*—Phthalocyanine blue and green pigments. **New York Color & Chemical Co.**
*Nylon*—Polyamide resin. **E. I. du Pont de Nemours & Co.**
*Nytal*—Talc. **R. T. Vanderbilt Co.**

## O

*ONB*—ortho-nitrobiphenyl plasticizer. **Monsanto Chemical Co.**
*OO Silica Smoke*—Amorphous Silica. **Tamms Industries, Inc.**
*Opalon*—Vinyl Chloride resin. **Monsanto Chemical Co.**
*Oronite*—Polybutene. **Oronite Chemical Company**
*Orthophen*—Amyl Phenols for antiskinning. **Sharples Chemicals Inc.**
*Ortholone Orange*—Ortho-Nitraniline Orange **Standard Ultramarine & Color Co.**

## P

*Paideos*—Paint deodorants. **Dodge & Olcott, Inc.**
*Paint Base Oil*—Special pigmented base oil. **Pacific Vegetable Oil Corp.**
*Paintodors*—Paint deodorants. **Sindar Corporation**
*Paisflex*—Polyvinyl acetate resin paint base (Internally Plasticized). **Paisley Products, Inc.**
*Paisley*—General Line of liquid labeling glues. **Paisley Products, Inc.**
*Palconate*—Surface active agent. **The Pacific Lumber Company**
*Palcotan*—Surface active agent. **The Pacific Lumber Company**
*Panaflex BN*—Hydrocarbon plasticizer. **Pan American Chemicals**
*Panapol*—Synthetic hydrocarbon drying oils. **Pan American Chemicals**
*Panarez*—Petroleum hydrocarbon resins. **Pan American Chemicals**
*Panasol*—High solvency aromatic solvents. **Pan American Chemicals**
*Para-Cymene*—Para-Cymene. **Newport Industries, Inc.**
*Paradene*—Coumarone-indene resins. **Neville Chemical Company**
*Paraplex*—Plasticizers and polyester resins. **Rohm &Haas Company**
*Parasepts*—anti-fungal and anti-bacterial agents. **Heyden Chemical Corporation**
*Parlon*—Chlorinated natural Rubber. **Hercules Powder Co.**
*Pavco Oil*—Bodied linseed Oil. **Pacific Vegetable Oil Corp.**
*Pavoil*—Bodied oil. **Pacific Vegetable Oil Corp.**
*Pavolene*—Refined linseed oil. **Pacific Vegetable Oil Corp.**
*Pavolin Oil*—Bodied linseed oil. **Pacific Vegetable Oil Corp.**
*Pavsoy*—Bodied Soybean Oil. **Pacific Vegetable Oil Corp.**
*Pavsynth*—Modified linseed oil. **Pacific Vegetable Oil Corp.**
*Pavwax*—Microcrystalline waxes. **National Wax Company**
*PC 1244*—defoaming agent. **Monsanto Chemical Co.**
*PCP Castor Oil*—Raw expeller oil, unbleached. **Pacific Vegetable Oil Corp.**
*PE-16*—Emulsion of chlorinated natural rubber. **Alfred Hague & Co., Inc.**
*Peerless*—Kaolin Clay. **R. T. Vanderbilt Co.**
*Penbro*—"B" Wood resin. **Newport Industries, Inc.**
*Penbro 83*—Limed wood rosin. **Newport Industries, Inc.**
*Penglo 65*—Tall oil penta ester solution. **Newport Industries, Inc.**
*Pennco*—Pigment Dispersions. **Pennsylvania Color & Chemical Co.**
*Pennsalt*—Metal Cleaners, alkaline paint strippers, and paint spray booth water conditioners. **Pennsylvania Salt Manufacturing Co.**
*Penros*—Polymerized wood rosin. **Newport Industries, Inc.**
*Pent Acetate*—Synthetic amyl acetate. **Sharples Chemicals Inc.**
*Pentacite*—Pentaerythritol resins. **Reichhold Chemicals, Inc.**

*Pentalyn*—Pentaerythritol esters of rosin and phenolic-modified pentaerythritol esters of rosin. **Hercules Powder Co.**
*Pentaphen*—Para-tertiary-Amilphenol. **Sharples Chemical Inc.**
*Pentasol*—Synthetic amyl alcohols. **Sharples Chemicals Inc.**
*Pentek*—Pentaerythritol technical. **Heyden Chemical Corporation**
*Perlin*—Chemically treated linseed oil. **Brown-Allen Chemicals, Inc.**
*Permadine*—Zinc Phosphate coating chemicals for rust-proofing. **American Chemical Paint Company**
*Permagel*—Processed Fullers Earth thickener. **Minerals & Chemicals Corp. of America**
*Permanent*—Phthalocyanine blue and green pigments. **New York Color & Chemical Co.**
*Petrex*—Unmodified Petrex alkyd resins. **Hercules Powder Co.**
*Petro A A*—Surface active agent. **Petrochemicals Company**
*Petrodor*—Paint solvent deodorants. **Dodge & Olcott, Inc.**
*Petrohol*—Isopropyl alcohol. **Enjay Company, Inc.**
*Petrolene*—Aliphatic petroleum thinner. **Anderson—Prichard Oil Corporation.**
*Petropon*—Heavy petroleum polymers. **American Mineral Spirits Company**
*Petro-Resins*—Polymerized olefinic hydrocarbons **Petroleum Specialties Company**
*Phthalo*—Phthalocyanine blue and green pigments. **New York Color & Chemical Co.**
*Picco*—Solvents & Solvent Oils. **Pennsylvania Industrial Chem. Corp.**
*Piccolastic*—Low molecular wt. polystyrene resins. **Pennsylvania Industrial Chemical Corporation.**
*Piccolyte*—Polyterpene resins. **Pennsylvania Industrial Chemical Corporation**
*Piccopale*—Petroleum hydrocarbon resin. **Pennsylvania Industrial Chemical Corporation**
*Piccopale Emulsion*—Petroleum hydrocarbon resin emulsion. **Pennsylvania Industrial Chemical Corporation**
*Piccoumaron*—Coumarone-Indene resins. **Pennsylvania Industrial Chemical Corporation**
*P-K*—Twin Shell Blender. **The Patterson-Kelly Co., Inc.**
*Planisol*—Surface active agent. **The Girdler Company**
*Plastoflex 520*—ester plasticizer. **Advance Solvents & Chemical Corporation**
*Plastolein*—Chemical & resinous plasticizers. **Emery Industries, Inc.**
*Pliolite latex*—Styrene-butadiene emulsions. **The Goodyear Tire & Rubber Co. Inc.**
*Pliolite, natural rubber*—cyclized natural rubber. **The Goodyear Tire & Rubber Co. Inc.**
*Pliolite S-5*—Styrene-butadiene resins. **The Goodyear Tire & Rubber Co. Inc.**
*Pliovic*—Polyvinyl chloride resins. **The Goodyear Tire & Rubber Co., Inc.**
*Plumb-O-Sil*—Stabilizers for vinyls. **National Lead Company**
*Pluronics*—Emulsifying agent (Nonionic). **Wyandotte Chemicals Corp.**
*PMAC*—High Boiling solvent polymethoxy acetal. **General Aniline & Film Corporation**
*PMN 10*—Fungicide. **Nuodex Products Co., Inc.**
*PMO 10*—Fungicide. **Nuodex Products Co., Inc.**
*Polyco*—Butadiene-Styrene, Acrylic and Polyvinyl Acetate Emulsions, Vehicles, Thickeners & Stabilizers. **American Polymer Corporation**
*Polyfon*—Surface active agents. **West Virginia Pulp and Paper Company**
*Polymer C-3*—Modified vinyl acetate resin. **Monsanto Chemical Co.**
*Poly-pale Ester*—Glycerol ester of polymerized rosin. **Hercules Powder Co.**
*Polywood Oil*—Heat treated wood oil. **Brown-Allen Chemicals, Inc.**
*Protatek 53*—Sodium alginate thickener. **Croda Incorporated**
*Protectoseal*—Equipment for protection against fires through the use of flammable liquids. **Protectoseal Co.**
*PT*—Pine tar, pine tar oil, pine oil, destructively distilled wood turpentine. **Godfrey L. Cabot, Inc.**
*Propocel*—Cellulose derivative. **The Dow Chemical Company**
*Purecal*—Ppt. Calcium Carbonate. **Wyandotte Chemicals Corp.**
*PVC 100*—Polyvinyl Chloride. **The Dow Chemical Company**
*PX Plasticizers*—Chemical and Resinous Plasticizers. **Pittsburgh Coke & Chemical Co.**
*Pycal*—Chemical Plasticizers. **Atlas Powder Co.**
*Pyrotone Reds*—Chlorinated Para Toners. **Standard Ultramarine & Color Co.**

## R

*R-856, R878 Resins*—Silicone—alkyd resins. **Dow Corning Corp.**
*Ramapo*—Resinated organic pigments. **E. I. du Pont de Nemours & Co.**
*Raven*—Carbon Black pigment. **Binney & Smith Inc.**
*R-B-H*—Pigment Dispersions. **R-B-H Dispersions**
*R C Plasticizer E S*—Polymeric Plasticizer. **Rubber Corporation of America**
*RD 910*—stabilizer—thickener. **Minnesota Mining & Manufacturing Co.**
*RECO Brown*—Concentrated brown iron oxides. **Reichard-Coulston, Inc.**
*Resimene*—Butylated melamine formaldehyde resins. **Monsanto Chemical Co.**
*Resimene-U*—Butylated urea formaldehyde resins. **Monsanto Chemical Co.**
*Resinox P97*—Phenolic resin. **Monsanto Chemical Co.**
*Resyn*—Polyvinyl acetate emulsions. **National Starch Products Inc.**
*Reynolds Metals*—Aluminum Powder & Paste. **Reynolds Metals Co.**
*Reynolized*—Aluminum Paste Pigment. **Reynolds Metals Co.**
*Rezyl*—Oil Modified Alkyd Resins. **American Cyanamid Company**
*Rheotol*—Surface active agent. **R. T. Vanderbilt Co.**
*Rhoplex*—Acrylic resin dispersions. **Rohm & Haas Company**
*Rodine*—Pickling acid inhibitors. **American Chemical Paint Company**
*Rubbersol # 3*— Terpene solvent. **Newport Industries, Inc.**
*Rustib*—corrosion inhibitor. **Raybo Chemical Company**

## S

*Safflower 22*—Isomerized Safflower Oil. **Pacific Vegetable Oil Corp.**
*Saflex*—Polyvinyl butyral. **Monsanto Chemical Co.**
*St. Joe*—Lead-free zinc oxide. **St. Joseph Lead Co.**
*Santicizer*—Chemical plasticizers **Monsanto Chemical Co.**
*Santocel*—Extender pigment, silica aerogel. **Monsanto Chemical Co.**
*Santolite*—Aryl sulfonamide—formaldehyde resins **Monsanto Chemical Co.**
*Sapona Reds*—Soapfast Reds. **Standard Ultramarine & Color Co.**
*Saran*—Vinylidene Chloride polymers. **The Dow Chemical Company**
*Sarkosyls*—Emulsifiers and anti-corrosive agents **Geigy Industrial Chemicals**
*Sealed-Disc*—Paint filters. **Alsop Engineering Corporation**
*Sequestrene*—Metal Complexing agent. **Geigy Industrial Chemicals**
*Ser-X*—Extender pigment; Sericite (hydrous aluminum silicate. **Innis, Speiden & Co., Inc.**
*Ship Pitch*—Pitch. **Newport Industries, Inc.**
*Sierra Fibrene*—Extender pigment; Talc (magnesium silicate). **Innis, Speiden & Co., Inc.**
*Sierra Mistron*—Extender pigment; Talc (magnesium silicate). **Innis, Speiden & Co., Inc.**
*Silastic*—Silicone rubber. **Dow Corning Corp.**
*Silex*—Extender pigment; Hard Silica. **Innis, Speiden & Co., Inc.**
*Skellysolve*—Aliphatic hydrocarbon solvents. **Skelly Oil Company**
*Smithko*—Pigments and extenders. **Smith Chemical & Color Company**
*Socal Petrolatum*—Waxes. **Standard Oil Co of Calif.**
*Socal Solvent*—Aromatic Solvents. **Standard Oil Company of California**
*Softex Red*—precipitated pure red oxide **Reichard-Coulston, Inc.**
*Solarite*—Hydrocarbon resin. **Solar Compounds Corp.**
*Soligen*—Driers. **Advance Solvents & Chemical Corporation**
*Solinox*—process linseed oil. **Spencer Kellogg & Sons Inc.**
*Solros*—Heat-treated wood Rosin. **Newport Industries, Inc.**
*Solvenol*—Mixed terpene solvent. **Hercules Powder Co.**
*Solvent # 30*—Terpene solvent. **Newport Industries, Inc.**
*Solvesso*—Aromatic petroleum solvents. **Esso Standard Oil Company**
*S-O-M*—Sight-O-Matic control of roll pressures **J. M. Lehmann Co., Inc.**
*Sorbo*—70% sorbitol solution. **Atlas Powder Co.**
*Sovasol*—Aliphatic petroleum solvents. **Socony—Vacuum Oil Co.**
*Soya Paint Oil*—Modified Soybean Oil. **Pacific Vegetable Oil Corp.**
*Soyalin*—Specially processed soybean oil. **Brown-Allen Chemicals, Inc.**
*Soya Solinox*—Process soybean Oil. **Spencer Kellogg & Sons Inc.**
*Soywood Oil*—Co-polymerized combination of refined soybean oil and tung oil. **Pacific Vegetable Oil Corp.**
*Span*—Emulsifiers; fatty acid esters of sorbitol anhydrides. **Atlas Powder Co.**
*Spangle*—aluminum paint improver. **Raybo Chemical Company**
*Sparmite*—Very fine barium sulfate. **C. K. Williams & Co.**
*Sparsol*—Vinyl type polymer. **Sparta Industries**
*Spectronic 20*—Colorimeter. **Bausch & Lomb Optical Co.**
*Speedee Mite*—"Miniature paint factory in a test tube" **Charles E. Barker Company**
*SR*—Silicone resins. **General Electric**
*Stabelan*—Vinyl stabilizers. **Harwick Standard Chemical Co.**
*Stabilizer D-22*—dibutyl tin dilaurate. **Carbide & Carbon Chemicals Company**
*Standard*—Zinc Dust. **New Jersey Zinc Co**
*Standard Refined Wax*—Waxes. **Standard Oil Company of California**
*Standard Thinner*—Aliphatic Thinners. **Standard Oil Company of California**
*Stardust*—Magnesium Silicate. **Tamms Industries, Inc.**
*Statex*—Carbon Black pigment. **Binney & Smith Inc.**
*Staybelite Ester*—Glycerol ester of hydrogenated rosin. **Hercules Powder Co.**
*Steelco*—Distilled Tall Oils. **K. A. Steel Chemicals Inc.**
*Sterling*—Carbon black pigments. **Godfrey L Cabot, Inc.**
*Strypp-Away*—liquid paint stripper. **The DuBois Co., Inc.**
*Styrast*—Polystyrene casting resins. **Emerson & Cuming, Inc.**
*Styresol*—Styrenated alkyd resins. **Reichhold Chemicals, Inc.**
*Styretex*—Styrenated alkyd resins. **Jones—Dabney Co.**
*Styron*—polystyrene. **The Dow Chemical Company**
*Sunolith*—Lithopone. **The Glidden Company**
*Super Ad-It*—Fungicide. **Nuodex Products Co., Inc.**
*Super Aetna Crimson red Oxide*—Produced from crude Persian Gulf Red Oxide. **Reichard-Coulston, Inc.**
*Super-Beckacite*—Pure phenolic resins. **Reichhold Chemicals, Inc.**
*Supercarbovar*—Carbon black pigments. **Godfrey L. Cabot, Inc.**
*Superfyde*—Formaldehyde polymer. **Heyden Chemical Corporation**
*Superjet*—Lampblack. **C. K. Williams & Co.**
*Superlin*—Catalyzed refined linseed oil. **Brown-Allen Chemicals, Inc.**
*Supercil*—Low acid refined linseed oil. **Brown-Allen Chemicals, Inc.**
*Super Spectra*—Carbon Black pigment. **Binney & Smith Inc.**
*Superba*—Carbon Black pigment. **Binney & Smith Inc.**
*Surfex*—Calcium Carbonate Extender Pigments. **Diamond Alkali Company**
*Suspenso*—Calcium Carbonate Extender Pigments. **Diamond Alkali Company**
*Susperse B*—anti-sagging, anti-settling, wetting and dispersing agent. **Raybo Chemical Company**
*Syloid*—Extender pigments; silica. **Davison Chemical Company**
*Synco*—Phenolic resins. **Snyder Chemical Corporation**
*Synco 935-D*—Cross-linking vinyl copolymer emulsion. **Snyder Chemical Corporation**
*SynPar*—Hard, High-melting Wax. **H. L. Barnebey**
*Syntex*—Alkyd resins. **Jones-Dabney Co.**
*Synthe-Copal*—Ester gum resins. **Reichhold Chemicals, Inc.**
*Synthenol*—Dehydrated castor oil. **Spencer Kellogg & Sons Inc.**
*Syn-U-Tex*—Butylated urea formaldehyde resins. **Jones-Dabney Co.**
*Synvarite*—100% phenolic resins. **Synvar Corporation**
*Synvarol*—Butylated urea resins. **Synvar Corporation**

## T

*Tasco*—Talc. **Tamms Industries, Inc.**
*T. C. Mictomite*—Calcium Carbonate. **Tamms Industries, Inc.**
*Tecquinol*—technical hydroquinone. **Eastman Chemical Products, Inc.**
*Tecsol*—proprietary solvent based on ethyl alcohol. **Eastman Chemical Products, Inc.**
*Teflon*—Tetrafluoroethylene resin. **E. I. du Pont de Nemours & Co.**
*Teglac*—Rosin Modified Dibasic Acid Resins. **American Cyanamid Company**
*Tenex*—Heat-treated wood Rosin. **Newport Industries, Inc.**
*Tergitol*—Nonionic and Anionic surface active agents. **Carbide and Carbon Chemical Company**
*Textile Spirits*—An aliphatic naphtha having an evaporation range similar to benzol. **American Mineral Spirits Company**
*T-Glo-8 & 8Y*—Tall oil gloss oil. **Newport Industries, Inc.**
*Thermax, P-33*—Carbon Blacks. **R. T. Vanderbilt Co.**
*Thermoil-Granodine*—Manganese iron phosphate coating chemicals for wear-proofing and rust-proofing. **American Chemical Paint Company**
*Thermolite*—Stabilizer for vinyls. **Metal & Thermit Corporation**
*Ti Cal*—Titanium calcium pigments. **E. I. du Pont de Nemours & Co.**
*Ti-Pure*—Titanium dioxide pigments, rutile and anatase. **E. I. Du Pont De Nemours & Co.**
*Titanolith*—Titanated lithopone. **The Glidden Company**
*Titanox*—Titanium Dioxide Pigments; Rutile, Anatase, Non-Pigmentary, Titanium Calcium **Titanium Pigment Corp.**
*TME*—Trimethylolethane. **Heyden Chemical Corporation**

*TP*—Trimethylolpropane. **Heyden Chemical Corporation**
*Tne*—Tall oil pitch. **Newport Industries, Inc.**
*Transphalt*—Asphaltic hydrocarbon resin. **Pennsylvania Industrial Chemical Corporation**
*Tungle*—Carbon Black. **United Carbon Co., Inc.**
*Tribase*—Stabilizers for vinyls. **National Lead Company**
*Tri-Homo*—Homogenizing machinery. **Tri-Homo Corporation**
*Tripentek*—Tripentaerythritol Technical. **Heyden Chemical Corporation**
*Triton*—Surface active agents. **Rohm & Haas Company**
*Troluoil*—Aliphatic petroleum thinner. **Anderson-Prichard Oil Corporation**
*Tween*—Emulsifiers; polyoxyethylene sorbitan fatty acid esters. **Atlas Powder Co.**
*Tyritchell*—Emulsifying agents. **Emery Industries, Inc.**
*Tyz-Bond*—Zinc phosphate coating for metal. **Cowles Chemical Company**

## U

*Ubatol*—Modified polystyrene emulsion. **Union Bay State Chemical Co., Inc.**
*Uformite*—Urea-formaldehyde and melamine-formaldehyde resins. **Rohm & Haas Company**
*Ultra-Turrax*—Colloid Mills. **Cartrite International, Inc.**
*Unitane*—Titanium dioxide pigment. **American Cyanamid Co.**
*Unitol*—Refined Tall Oil. **Union Bag & Paper Corp.**
*USS*—Aromatic hydrocarbon solvents. **United States Steel Corporation**
*Utilitank*—Glass lined storage tanks. **The Pfaudler Co.**

## V

*Vancide*—Fungicides. **R. T. Vanderbilt Co.**
*Vandor*—Paint Deodorant. **van Ameringen-Haebler, Inc.**
*Varayd*—Line of Varnishes. **Farnow Varnish Works**
*Varez*—Resin Solutions. **McCloskey Varnish Co.**
*Varkydols*—Special Drying Oils. **McCloskey Varnish Co.**
*Varkyds*—Alkyds, Phthalic, Non-Phthalic and Modified. **McCloskey Varnish Co.**
*Veegum*—Magnesium Aluminum silicate. **R. T. Vanderbilt Co.**
*Velsicol*—Hydrocarbon resins and aromatic hydrocarbon solvents. **Velsicol Corporation**
*Velveteen "R" Silica*—Amorphous Silica. **Tamms Industries, Inc.**
*Venus Natural Copper*—Flake Copper Powder. **U. S. Bronze Powder Works, Inc.**
*Venus Palegold*—Gold Bronze Powder. **U. S. Bronze Powder Works, Inc.**
*Vi-Cron*—Very fine ground limestone. **C. K Williams & Co.**
*Vinac*—Polyvinyl acetate resins and emulsions. **The Colton Chemical Company**
*Vinsol*—Resin derived from southern pine wood. **Hercules Powder Co.**
*Vinsol Ester Gum*—Glycerol ester of Vinsol. **Hercules Powder Co.**
*Vinylite*—Vinyl resins: acetate, chloride-acetate, Chloride, alcohol, and butyral. **Bakelite Company**
*Violite*—Luminescent Pigments. **Rhode Island Laboratories, Inc.**
*Virginia Red Toners*—Chlorinated Lithol Rubine. **Standard Ultramarine & Color Co.**
*Viskoplus*—Aluminum naphthenate. **Advance Solvents & Chemical Corporation**
*Vistac*—Hydrocarbon resins. **Advance Solvents & Chemical Corporation**
*Vulcan*—Steel Shipping containers. **Vulcan Stamping & Mfg. Co.**
*VVF Pigments*—Very fine natural iron oxides. **C. K. Williams & Co.**

## W

*Wallkyd*—Alkyd resin vehicles. **Reichhold Chemicals, Inc.**
*Wallpol*—Plasticized vinyl acetate emulsion. **Reichhold Chemicals Inc.**
*Walltax*—Wall sizings. **Hayes Adhesives Co., Inc.**
*Watchung*—Permanent red 2B pigments. **E. I. du Pont de Nemours & Co.**
*Weather-Ometer*—Accelerated Weathering Machines. **Atlas Electric Devices Co.**
*Wet-Ege Spirits*—Aliphatic hydrocarbon thinner. **Anderson-Prichard Oil Corporation**
*Witall*—Tall oil driers. **Witco Chemical Co.**
*Witcarb*—Precipitated calcium carbonate. **Witco Chemical Company**
*Witco*—Paint driers and industrial chemicals. **Witco Chemical Company**
*Witcoblak*—Color carbon blacks. **Witco-Continental**
*Wollastonite*—Calcium Metasilicate extender pigment. **Godfrey L. Cabot, Inc.**
*Wonex*—Soda-treated wood rosin. **Newport Industries, Inc.**

## X

*XR-859, XR-875 Resins*—Silicone—phenolic resins. **Dow Corning Corp.**
*XX*—Lead-free Zinc Oxide. **New Jersey Zinc Co.**

## Z

*Zinar*—Zinc resinate. **Newport Industries, Inc.**
*Zinol*—Zinc resinate solution. **Newport Industries, Inc.**
*Zirex*—Zinc resinate. **Newport Industries, Inc.**
*Zitro*—Zinc resinate. **Newport Industries, Inc.**
*Zopaque*—Titanium dioxide. **The Glidden Company**
*Zulu*—Phthalocyanine blue & green pigments. **Kentucky Color and Chemical Co.**
*Zytel*—nylon resin. **E. I. du Pont de Nemours & Co.**

## NUMBERED

*41 Grease*—Silicone grease, heat resistant. **Dow Corning Corp.**
*"100 Series" Oxides*—Bright pure red iron oxides. **C. K. Williams & Co.**
*129G*—Silicone resin for masonry water repellents. **Dow Corning Corp.**
*200 fluid*—Silicone additive for paints & enamels. **Dow Corning Corp.**
*400 Gum*—Dimethyl silicone polymer. **Dow Corning Corp.**
*#400 Silver Bond "B" Silica*—Crystalline Silica. **Tamms Industries, Inc.**
*802-806,840 Resins*—Silicone resins. **Dow Corning Corp.**

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**Nutting Truck and Caster Company Inc.**
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## O

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